REPORT RESUMES

ED 010 541 64

THE USE AND DEVELOPMENT OF PROGRAMED MATERIALS AND MEDIA IN PRIVATE LIBERAL ARTS COLLEGES.

BY- DEHAAN, ROBERT F.
GREAT LAKES COLL. ASSN., DETROIT, MICH.

REPORT NUMBER NDEA-VIIB-365 PUB DATE 30 JUN 66
HOPE COLLEGE, HOLLAND, MICH.
REPORT NUMBER BR-5-0988
CONTRACT OEC-3-16-041
EDRS PRICE MF-$0.54 HC-$14.88 372P.

DESCRIPTORS- *PROGRAMED INSTRUCTION, *MATERIAL DEVELOPMENT, *LIBERAL ARTS, *COLLEGE INSTRUCTION, *COOPERATIVE PROGRAMS, PROGRAM EVALUATION, DETROIT, HOLLAND, MICHIGAN

THE DEVELOPMENT AND EVALUATION OF PROGRAMED INSTRUCTIONAL MATERIALS FOR USE IN PRIVATE LIBERAL ARTS COLLEGES WERE REPORTED. MEMBER COLLEGES OF THE GREAT LAKES COLLEGES ASSOCIATION (GLCA) PARTICIPATED IN THE (1) IDENTIFICATION OF AREAS WHERE PROGRAMED INSTRUCTION MIGHT BE APPLIED, (2) REVIEW OF EXISTING COMMERCIAL PROGRAMS, (3) DEVELOPMENT OF NEW MATERIALS, (4) PROMOTION OF BASIC RESEARCH IN INSTRUCTIONAL PROGRAMING, AND (5) EVALUATION AND COMPARISON OF THE NEW MATERIALS AND METHODS OF DEVELOPMENT. THE RESULTS INDICATED THAT THE PROJECT DEMONSTRATED THE VALUE OF HAVING AN ASSOCIATION OF COLLEGES PREPARE AND EVALUATE JOINT PROGRAMS. IN ITS 3 YEARS OF OPERATION, THIS PROJECT DEVELOPED 36 PROGRAMS. FROM THESE, FIVE PROGRAMS WERE SELECTED AND SUBJECTED TO INTENSIVE EVALUATION UNDER A VARIETY OF TEACHING CONDITIONS. SUBJECT AREAS OF THE PROGRAMS EVALUATED WERE POETRY, LOGIC, BIOCHEMISTRY, RELIGION, AND POLITICAL SCIENCE. (RS)

B-365
5-0988

ED010541

THE USE AND DEVELOPMENT OF PROGRAMED MATERIALS AND MEDIA IN PRIVATE LIBERAL ARTS COLLEGES

Contract Number OE 3-16-041

Final Report

U. S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
Office of Education
This document has been reproduced exactly as received from the person or organization originating it. Points of view or opinions stated do not necessarily represent official Office of Education position or policy.

by

Robert F. DeHaan

June 30, 1966

This document does not necessarily reflect United States Office of Education policy and does not, in itself, constitute a standard, specification, or regulation.

GREAT LAKES COLLEGES ASSOCIATION

Project Office
HOPE COLLEGE
HOLLAND, MICHIGAN

The study reported herein was performed pursuant to a contract with the United States Office of Education, Department of Health, Education and Welfare.

CONTENTS

Introduction...iii

Acknowledgments.. vi

Part I Description of the Project......................

1. The First Year.....................................

2. The Second and Third Years.......................

3. Products of the Project..........................

Part II Evaluation of Programed Instructional Material..

4. Review of Research in Programed Instruction at the College Level............................

5. Evaluation of Commercial Programs...............

6. Evaluation of GLCA Produced Programs............

Part III Impact of Preparing Programed Materials.........

7. The Process of Preparing Programed Materials as a Means of Illuminating Teaching............

8. Informal Evaluation of Programing as a Means of Illuminating Teaching........................

9. Formal Evaluation of Programing as a Means of Illuminating Teaching..........................

Part IV Summary, Conclusions and Recommendations........

ACKNOWLEDGEMENTS

The Great Lakes Colleges Association Programed Instruction Project was a team effort from its inception to its conclusion. A conference of representatives from the colleges created it. All the colleges participated at many different levels in carrying it through. Both human resources and facilities of the colleges have been made available to the project. From faculty members and administrators of the colleges have come ideas that have significantly enriched the ends and means of the project.

A most significant factor in whatever success the Project has achieved has been the contribution of Dr. Eldon Johnson, President of the Great Lakes Colleges Association. He consistently stood ready to help and advise. He regularly called the Project to the attention of the GLCA Board of Directors and made essential contacts with agencies and institutions outside the association as well as within it. The Board of Directors in its own right has been most attentive to the development of the Project and has never failed to appreciate the significance of the Project in relation to learning and teaching going on in the classrooms of the colleges.

A number of GLCA men have contributed technical and professional services to the project. Dr. Daniel Smith of Earlham College served well as a constant advisor to the project director and wrote Chapter 4. Dr. Donald Beane of the College of Wooster took over the task of coordinating the evaluation of commercial programs and the much more demanding one of the coordinating the two dozen projects that evaluated GLCA produced programs. His insistence on excellence enhanced the success of the evaluation procedures and resulted in a report which will undoubtedly become one of the most significant contributions of the Project. In addition he is the major author of Chapters 5 and 6.

Mr. William Jensen, Director of the Computer Center at Kalamazoo College, along with Lyle Anderson, computer programer, provided the key link with modern computer technology that made possible the handling of reams of data from the evaluation projects. Dr. Sam Cho of the College of Wooster served admirably as the statistical consultant to the studies of the effectiveness of GLCA-produced programs. Dr. Clarence Leuba, recently retired from the chairmanship of the Department of Psychology at Antioch College, assisted in the study of the impact of program writing upon the process of teaching and co-authored Chapter 9. Dr. James Cook, English Department, Albion College edited the entire report. These men made a lasting contribution to the research and administration of the project.

The Liaison Committee as a group and the liaison persons individually interpreted the project on their campuses, advised the director on policy decisions and kept the director in touch with climates of opinion on respective campuses. No group on the project gave more unstintingly of its time, and that without stipend. The programers, program evaluators, field testers, occasional special consultants, and conferees, can be numbered by the scores. Through them the front line activities of development and dissemination of programed material was accomplished.

The Deans and Presidents of the colleges were consistently concerned for the success of the project and for translating its results into ever improved teaching procedures.

Through the training workshop, conducted for the GLCA programers during the summer of 1964, the staff of the Center for Research on Learning and Teaching of the University of Michigan contributed more to the success of the Project than did any other institution outside the Association.

The administration of Hope College generously made available to the project facilities, materials, and services--the kind for which there is no budget category--and provided a leave of absence for the director to work on the Project.

To Mrs. Elaine Van Liere, the project secretary, has fallen the task of keeping track of the countless details connected with budget control, filing, and typing an endless stream of memoranda. All of this she did with efficiency and poise.

INTRODUCTION

The Great Lakes Colleges Association Programed Instruction Project had its origin in an authorization of the Board of Directors of the Great Lakes Colleges Association dated January, 1962. The board approved formulating a proposal for a project dealing with programed instructional materials at the college level. To that end a conference was called on March 23, 24, 1962, at which time the potential of programed instruction for college teaching was discussed with reference to experiences already gained at Antioch, Earlham, and Oberlin Colleges. From this conference came the first draft of a proposal and a series of agreements about the nature of the proposed project. Dr. Daniel Smith of Earlham College, with the assistance of others, assumed responsibility for formulating the final draft of the proposal.

Members of the conference, appointed by their presidents, representing all the colleges in the association except Kenyon were the following:

Albion College, Dr. Paul Carnell

Antioch College, Dr. William S. Johns

Denison University, Dr. Dewey Slough

De Pauw University, Dr. Clark Norton

Earlham College, Dr. Daniel Smith

Hope College, Dr. Ralph Perry

Kalamazoo College, Dr. Walter Waring

Oberlin College, Dr. Celeste McCollough

Ohio Wesleyan University, Dr. Francis Alter

Wabash College, Dr. George Lovell

College of Wooster, Dr. John Warner

GLCA President, Dr. Eldon Johnson

Though GLCA submitted the proposal to a foundation in May, 1962, it lay dormant until March 1963, at which time the Research Committee of the Great Lakes Colleges Association consisting of chairman Dr. Samuel Baskin, Antioch College; Dr. Paul Carnell, Albion; Dr. Robert De Haan, Hope College; and Dr. Celeste

McCollough, Oberlin College; decided to submit the proposal to the U. S. Office of Education. The U. S. Office of Education accepted the proposal for support and funded it in the summer, 1963 under Public 85-864 Title VII, Part B, Dissemination activities concerned with the more effective utilizations of media for educational purposes.

In the summer of 1963, the Great Lakes Colleges Association initiated its PROGRAMED INSTRUCTION PROJECT with supporting funds from the U. S. Office of Education. Originally a two-year project, it was extended for one year in 1965.

The project began with the following objectives:

1. To determine areas within the curriculum common to the same department in the various colleges which may be covered adequately by programed self instruction;

2. To determine specific behavioral objectives to be achieved in the areas under 1 above;

3. To review existing programs to identify those which promise to fulfill the objectives under 2 above, and arrange for detailed evaluation and field testing of these programs;

4. To develop programed learning sequences wherever the objectives determined in 2 above cannot be achieved through programs identified in 3;

5. To promote basic research in instruction related to objectives which have been determined in 1 and 2 above, but which cannot be satisfied through activities under 3 and 4;

6. To evaluate the broader effects of programed instruction.

Dr. Robert F. De Haan, Professor of Psychology and Chairman of the Department at Hope College, Holland, Michigan was appointed Director of the Project.

Extension of Contract to June 1966

The attainment of some of the objectives of the original contract, especially objective number 6, "the evaluation of the broader effects of programed instruction", depended upon the construction of a number of programs which because of sheer lack of time in the first two years of the project were not produced. After the summer of 1964 a large number of programs were on hand and it became possible to proceed to evaluate them out in a variety of situations, thereby gathering the data and experience necessary for the attainment of objective number 6.

An extension of the contract to June 1966 was negotiated in the Spring of 1965. The overall objective of the extension of the contract became that of evaluating the broader effects of programed instruction on the total instructional process in the liberal arts college setting. The objectives given below specify in greater detail the meaning of this objective. They are as follows:

1. To evaluate and compare the uses of programed instructional material prepared in 1964 in as great a variety of instructional situations as possible.

2. To study the effects of evaluating programed material and the effects of preparing programed material on the instructional processes and to ascertain which of the two has the greater impact on instructional processes.

3. To compare two methods of preparing programed material individual and team preparation on subsequent instructional processes, that is, do programers working individually or as a team have greater effect on the instructional processes?

4. To disseminate the results of the project to other small liberal arts colleges.

Beginning and Ending Dates: June 27, 1963, to June 27, 1965.
Extension to June 30, 1966.

Contractor: The Great Lakes Colleges Association, Detroit Metropolitan Airport, Michigan, Dr. Eldon L. Johnson, President.

Director: Dr. Robert F. DeHaan, Hope College, Holland, Michigan.

OK

Format of the Final Report

The first two chapters introduce the reader to the administration of the Project giving special emphasis to the methods for preparing programed materials, evaluating both commercial and GLCA produced programs, and disseminating information about programed instructional materials among GLCA colleges.

The third chapter reports the results of the project in terms of the number of programs produced, each of which is described in some detail. The results are also given in terms of the evaluation of the deans and in terms of effeciency of preparing programed materials.

The first three chapters deal with the attainment of the first four objectives of the original contract.

The fourth chapter reviews selectively the research on programed instruction. This chapter serves as an introduction to the remaining chapters of the report.

Chapter 5 reports the evaluation of commercial programs and serves specifically to meet the third objective in the original contract.

The sixth chapter is perhaps the central chapter in the report in that it is an evaluation of GLCA produced programs. In this chapter the first objective of the extended contract is attained.

Chapter 7 discusses the rationale for preparing programed material and shows in a theoretical way its relationship to certain aspects of teaching. This chapter introduces the next two chapters. The three chapters together report the attainment of objective six of the original contract and objective two of extended contract.

Chapter 8 is a brief report of a preliminary study made of the impact of programing on teaching. Chapter 9 is a report of a pilot study of the relationship between programing and teaching made under more controlled conditions.

Chapter 10 summarizes and concludes the report and makes recommendations for further development and research.

The appendices for all the chapters are grouped in Part V.

Part I Description of the Project

PRECEDING PAGE BLANK- NOT FILMED

Chapter 1

THE FIRST YEAR

Preliminary Visits to GLCA Colleges

To acquaint the GLCA administrative personnel, particularly the presidents and deans, with the Project, and to become acquainted with them, late in the summer and early in the fall of 1963, the Director made a preliminary visit to each of the colleges in the Association. On each campus he was cordially received, and college administrators expressed a good deal of enthusiasm for the Project.

Changes in Procedures which Eventually Led to Amendment to Contract

In the course of his preliminary visits someone suggested a change in the operation of the Project. As it stood, the contract called for only three persons developing new programs on a half-time basis each year. A larger number of persons could be involved in the development of programs if each of them worked for a shorter period of time, for example, during the summer. Thus, instead of only six persons developing programs from all the GLCA colleges, two or three dozen could be involved without greater cost to the project. Also, limiting the production of programs to the summer vacation period avoids disruption of staff teaching functions in the college. The advantages of such a plan for disseminating knowledge about and creating knowledge in programed instruction were immediately obvious. The Director, in consultation with GLCA presidents and officials, decided to recommend the change in plans to the Office of Education.

A second decision was made in the course of the preliminary visits to the colleges: Each person preparing programed material would be expected to participate in a training workshop as part of his responsibility. Rather than assume that a faculty member could produce a program without being trained in the special techniques of writing programs, the Project was to provide a period of intensive training for him. These early changes made a great impact upon the future course of the Project.

Eventually, too, the Liaison Committee and the Director decided that more information would be gained about the effectiveness of programs by evaluating a relatively small number of them in depth under carefully controlled conditions than by evaluating a large number of them qualitatively under less controlled conditions.

Orgainzation of Liaison Committee

The Director asked the presidents and the deans of the colleges to submit names of persons to serve on the Liaison Committee. They

OK

were instructed to select members from the faculty and to avoid as much as possible naming administrators as liaison persons. The names of these persons were submitted to the Office of Education for approval as per contract. A number of the liaison persons appointed had served on the original committee that drafted the proposal for the Project.

The members of the Liaison Committee were:

Albion College
Dr. Paul Carnell, Chairman, Department of Chemistry
2nd year - Dr. Dean Dillery, Department of Biology

Antioch College
Dr. Robert MacDowell, Associate Professor of Mathematics
9 3rd year - Professor Richard Meislar, Department of Philosophy. Philoso

Denison University
Dr. Irvin Wolf, Professor of Psychology

DePauw University
Dr. Clark Norton, Director of Graduate Studies; Asst. Dean of the University, Professor of Political Science
2nd year - Dr. Kenneth Wagoner, Chairman, Department of Psychology

Earlham College
Dr. Daniel Smith, Assistant Professor of Education, Coordinator of Self-Instruction

Hope College
Dr. Ralph Perry, Professor Romance Languages Department

Kalamazoo College
Dr. Walter W. Waring, Chairman, Department of English

Kenyon College
Dr. Bruce Haywood, Dean of the College

Oberlin College
Dr. Loche Van Atta, Associate Professor of Psychology

Ohio Wesleyan University
Dr. Francis Alter, Chairman, Department of Education
3rd year - Dr. Joseph Wetmore, Professor of Education

Wabash College
Dr. Paul Mielke, Associate Professor of Mathematics

College of Wooster
Dr. Donald G. Beane, Assistant Professor of Education
3rd year - Dr. Sam Cho, Department of Psychology

First Liaison Committee Meeting

The Liaison Committee first met on Friday, October 10, 1963 at the Indianapolis Airport Hotel. All the colleges were represented at this first meeting except Kenyon and Oberlin. Since most of the liaison members were new to the Project, the Director spent most of the session outlining the Project for them. Topics discussed included: the time table of the Programed Instruction Project, the role of the liaison person, and the Director's schedule and activities. A proposed structure of initial campus conferences with faculty members for the fall of 1963 was established and a procedure for these conferences outlined as described below. This meeting also resulted in preliminary plans for the structure of the Winter Work Conferences for winter of 1964, definition of the role of the GLCA programer, and plans for the 1964 summer workshop and media production schedule.

At its first meeting, the Liaison Committee made specific plans and set dates for the next visit of the Director to the various campuses. The purposes of this visit were to present the general outline of the Project to the faculties, particularly to the department chairmen, and to consult with faculty members who might be interested in preparing programed material during the summer of 1964 under the aegis of the Programed Instruction Project. The arrangements for the initial campus conferences were made by the liaison persons. The liaison person also acted as contact person during the visit of the Director.[1]

In each college the Director followed the same general plan of introducing the Project. The Director described the Programed Instruction Project at a faculty meeting.[2] The length of time allotted to the presentation at the faculty meeting varied from ten to thirty minutes. Questions were invited at each meeting, but only rarely were any forthcoming. The entire day following the faculty meeting was then devoted to conferences between the Director and interested faculty members. At some colleges only one or two persons appeared for individual conferences, and at others there were as many as 15 to 20. The Director helped the faculty members to isolate areas and topics in their disciplines which might be programed with the support of the project. On the second day at a luncheon meeting the Director explained the Project to departmental chairmen in greater detail and allowed time for further questions.

---

[1] See Appendix A-1, for Director's visiting schedule and the number of faculty contacts at each college.

[2] Except at Earlham College where the faculty meeting was cancelled for administrative reasons.

The Director introduced his presentation at the faculty meetings with a statement that a new assessment of the effectiveness of higher education could be made through the Programed Instruction Project. The Director defined and described programed instruction, mentioning programed textbooks, branching programs, adjunct programs, language labs, and "single concept" films. He presented the two major thrusts of the Project: the development of new programs suitable for small liberal arts colleges, and the testing of existing programs. He also sketched out the general plan of operation for the GLCA Programed Instruction Project: Winter Work Conferences, a programers' workshop, summer production of programs, and fall evaluation of commercial programs.

er

The Director deposited with each liaison person a number of Faculty Participation Questionnaires (FPQ) and Departmental Questionnaires (DQ). The first of these was an instrument designed to encourage and assess faculty participation in the Programed Instruction Project whereby faculty members could indicate the level of participation in the Project they would prefer for themselves. The DQ was designed to find out the extent to which various departments were using programed materials. The liaison person collected the complete FPQs and the DQs after the Director's visit and forwarded them to his office. From the FPQs were drawn the names of faculty members who were interested in participating in the Winter Work Conferences as well as those who were interested in preparing, testing, or inspecting programs during the summer of 1964.[3]

X out

Departmental Meetings in the Colleges

The original contract with the Office of Education called for departmental meetings as follows:

> Departmental leaders will conduct a series of departmental meetings to discuss and develop the following areas:
>
> (a) areas within the subject which might profitably be covered by the use of programed self-instruction and media through which they might be presented effectively;

---

[3] See Appendix A-2, for a summary of results of FPQ, indicating faculty willingness to test and inspect published programs and GLCA programs.

(b) specific behavioral objectives to be achieved within these areas;

(c) existing programed materials which might achieve these behavioral objectives and thus be worth further testing;

(d) a roster of faculty members interested in either evaluating existing programs (including construction of tests and outlining of content) or developing new ones; and

(e) a roster of faculty members interested in devoting time and effort to attend a subsequent conference to spell out in detail the recommendations of various colleges in each subject area.

It became clear to the Director on his initial contacts with the faculties of the GLCA that this part of the contract overestimated the interest of the faculty members in programed instructional materials and their sophistication in the use of such materials. The very terminology such as "specifying behavioral objectives" and "identifying areas to be programed" was objectionable to a number of faculty members. Since the Director had no control over departmental chairmen, he could do no more than advise and urge them to hold departmental meetings about programed instructional materials.

It was also difficult to designate areas within a subject matter that could be programed. The interest is producing programed material seems to grow in a particular faculty member who is excited about some topic or problem in his discipline which he feels might lend itself to being programed and has relatively little to do with whether or not the topic is one that is of great interest to a department or to a profession in general. Desire to write programed material is more closely related to the teaching interests of individual faculty members than to departments. Thus the departmental approach to developing interest in programed materials, although sound for a long-term project, was not possible in a two-year project. It was more than could be expected of the departments to accomplish in two months what is outlined from (a) through (e) in the above paragraph in the contract.

If the contract had been followed explicitly, it is doubtful whether sufficient momentum could have been generated in time for participants to be selected from the departments for the Winter Work Conferences and for the preparation of proposals to produce programed instructional materials during the summer of 1964.[4] Departments were therefore bypassed in trying to recruit faculty persons to attend the Winter Work Conferences and to prepare programed materials. Participants were recruited directly by the liaison persons using the FPQ. The work that was delegated to the departmental meetings in the contract was assigned instead as a major objective of the Winter Work Conferences.

College Level Programed Materials Library

By the end of 1963, a number of published programs had been received by the Programed Instruction Project. On January 17, 1964, a list of them was sent to the liaison persons to serve as a bibliography for departments and individual faculty members who were interested in programed instructional materials. The number of programs received is included in Appendix A-3.

Second Liaison Committee Meeting

The second meeting of the Liaison Committee was held at Middleton House on the campus of Denison University in Granville, Ohio, on January 10, 1964. The major purposes of the meeting were to plan the Winter Work Conferences and to make preliminary plans for the summer 1964 preparation of programed materials. The Liaison Committee suggested that the "specification of behavioral objectives" by each department would be a desirable goal for the Winter Work Conferences. The Liaison Committee did not however, approve of the term "behavioral objectives," as used in the contract. The term smacked of educational jargon. In addition, the committee was concerned that the faculty members from the different colleges would feel coerced if they all were expected implicitly to reach agreement on them. They strongly resisted such pressure. The term "educational objectives" was adopted.

The Winter Work Conferences

The objectives of the Winter Work Conferences were to:

1. Get acquainted with colleagues, compare notes on teaching, programing, media.

---

[4] As further indication of the inability of departments to come to grips with issues presented in the contract, Appendix A-4, outlines the number of Departmental Questionnaires and the reaction of the department to programed instruction that were returned to the project office.

OK

2. Look over published programed materials that will be supplied for the conference. Decide whether to test any of the available programs in GLCA colleges.

3. Review disciplines to discover areas most amenable to programed instruction, discuss educational objectives that apply to those areas, and formulate tentative plans for future work in discipline.

4. Review submitted proposals for preparing programed material in the summer of 1964 with faculty members who submitted them. Make suggestions and recommendations about testing materials and developing new materials.

S

Invitations were extended to faculty members who had indicated their interest by means of FPQ.[5] The liaison persons also submitted additional names of persons to receive invitations. The conferences followed the schedule below:

sched

February 28 and 29 - Humanities Winter Work Conference

March 6 and 7 - Natural Sciences Winter Work Conference

March 20 and 21 - Social Sciences Winter Work Conference

The conferences were held at the Avis Hotel in Detroit Metropolitan Airport, and each followed a similar format. The following schedule is typical:

GLCA - PROGRAMED INSTRUCTION PROJECT
Social Sciences Winter Work Conference[6]

Conference Program

Friday, March 20, 1964

10:00 - 10:15	Greeting from GLCA, Eldon L. Johnson, President
10:15 - 10:30	Objectives of the Conference, Robert F. DeHaan, Director

---

[5] Lists of Participants in the three Winter Work Conferences are given in Appendices a-5 to A-7.

[6] For a list of resource persons used at each conference, see Appendix A-8. Their task was to work with each of the departments to help them think through the problems of programing for their particular discipline.

10:30 - 11:30	"The Process of Programing" - Dr. George Geis, Center for Research on Learning and Teaching, University of Michigan.
11:30 - 12:30	First departmental meeting
12:30 - 1:30	Luncheon
1:30 - 3:00	"Theoretical Background to Programing Instruction" - Dr. Dan Smith, Director, Self-Instruction Project, Earlham College.
3:00 - 3:30	Coffee Break
3:30 - 5:00	Second departmental meeting
5:00 - 6:00	Free Time
6:00 - 7:30	Dinner
7:30 - 8:30	Group Discussion, DeHaan, Resource Persons

Saturday, March 21, 1964

9:00 - 10:30	"Other Media for Self-Instruction in the Social Sciences", Joan Rosengren, Project on Educational Communication, Teachers College, Columbia, Univ., New York, New York
10:30 - 12:00	Third departmental meeting
12:00 - 1:00	Luncheon
1:00 - 3:00	Fourth departmental meeting
3:00	Adjournment

It should be noted in passing that the Director was hard pressed to find consultants for each discipline represented in the conferences. At the time of the Winter Work Conferences no one could be found with sufficient experience in programing in disciplines such as history, home economics, and art to act as a consultant. For several other areas, for example, speech, political science and music, only one person could be found. The present project is likely to establish a pool of persons in GLCA who will be expert both in their disciplines and in programing to serve as consultants to other colleges and college groups.

A summary by colleges and by disciplines of participants at the Winter Work Conferences is given in Appendix A-9.

Participants' Evaluation of the Winter Work Conference~~s~~ s

In their written evaluations of the meeting participants in the Winter Work Conference mentioned most often the helpfulness of the overall view of programing. About 40 of the members made some reference to a broadened understanding of the usefulness of programed material, of its aims, and of the value of taking a new look at teaching and learning. An additional 10 people mentioned the helpfulness of specific speakers, Smith and Geis. Participants also emphasized the value of the interaction with faculty persons from other colleges and of the exchange of ideas and information about teaching and programing on both departmental and interdisciplinary bases.

Meetings of departmental discussion groups stimulated thinking about programing possibilities and about evaluating teaching methods already being used. About 20 persons mentioned help from resource persons in these discussion groups. The opportunity to examine available programs was stimulating to many of the participants, and 18 of them mentioned that this was their first opportunity to take more than a cursory look at this material. S About 35 persons found contact with an expert in the programing field helpful to their understanding of both program writing and program use in the classroom. Of the 20 persons who listed specific information on program writing, 7 went on actually to write a program. Thus, the Winter Work Conference provided many of the participants a much needed overview of the process and potentials of programing.

Director's Evaluation of Winter Work Conferences

The Winter Work Conferences achieved several positive accomplishments. For most of the participants this was the first GLCA conference, and getting acquainted with colleagues and comparing notes on teaching and programed media were of highest priority. In this process many persons also became familiar with programed materials available and considered applications for these materials in their own teaching. Beyond this a major accomplishment of the conferences involved reviewing and completing proposals for pro the preparation of programed materials during the coming summer. The Director and Dr. Daniel Smith went over a number of proposals with their authors. In addition the conference stimulated several more faculty members to submit proposals.

Despite these successes, however, the Winter Work Conference left some goals unachieved. First, the entire problem of evaluating commercial programs was still unsolved at the end of the conference and was left to be approached more systematically at the May 8 Liaison Committee meeting. Moreover, except for the chemistry out economists, the Librarians, and to some extent, for the foreign-language group, departmental groups did not succeed in finding

Move out

areas amenable to programed instruction nor in discussing educational objectives in those areas. Appendix A-13 has Chemists' report.

Selection of Summer 1964 Programers

Besides the workshop, another major activity during the winter of 1964 was the gathering of proposals from faculty members of the Great Lakes colleges to prepare programed materials during the summer of 1964. This activity reached a climax during the Winter Work Conference and culminated in the awarding of 24 programing grants for the summer of 1964, subject to the approval of the revised contract and budget of the Office of Education.

The procedure used in obtaining proposals was as follows: An announcement of the opportunities to prepare programed materials during the summer of 1964 was made at each college during the Director's initial campus conference during the fall of 1963 and early winter 1964. At the close of each visit the Director left with the liaison person a number of FPQs which were to be given to faculty members whereby they could indicate as individuals their proposed level of involvement.

As mentioned earlier, the first contact with many potential programers was made during the Director's initial visits to the campuses. At this point he talked with a number of faculty members who were interested in programing and helped them prepare tentative proposals for writing programed materials during the summer of 1964.

Faculty members were invited by means of the FPQ and by a follow-up application form to submit proposals for summer work grants. The application for the summer work grant to prepare programed materials contained the following questions:

1. What part of your discipline do you propose to program?
2. In what way is the content you plan to program important? For example, is it important because so many students are involved in learning it? because it is so difficult to learn? because there is no time to deal with it is class, etc.?
3. What do you expect students to learn from your program? What objectives have you established? Be as specific as possible.
4. Is there anything unique about your plan of procedure that should be noted?
5. Describe any other features of your plan that do not fit readily into the above category of questions.

6. If you propose to do research on programed instruction rather than prepare programed materials, please outline your purpose, hypotheses, procedures, expected outcomes.

Sixty-one questionnaires containing proposals for preparing programed material were returned to the office of the Programed Instruction Project. After the Winter Work Conferences another 13 proposals were received. Distribution of the proposals received and grants awarded by colleges is given in Appendix 10. It is notable that there is a rather high, positive correlation between number of proposals submitted by each college and the number of programing grants awarded to it.

abl
apa

Six of the summer programing grants were awarded earlier than the rest because the persons making the proposals had to meet an early deadline for commitment for the summer's work. The Director, in consultation with Drs. Dan Smith of Earlham College and Paul Carnell of Albion College agreed on the value of these proposals and accepted them for Summer Work Grants.

Persons submitting proposals were informed that the final awarding of grants would be made by a subcommittee of the Liaison Committee at the end of March, 1964. Each one who submitted a proposal was encouraged to attend one of the Winter Work Conferences, to review his proposal with colleagues, revise it if necessary in the light of what the colleagues recommended, and then resubmit the proposal. A subcommittee of the Liaison Committee, consisting of Drs. Dan Smith, Earlham and Locke Van Atta, Oberlin, reviewed the proposals on March 27, 1964. No explicitly stated criteria for selecting the programs were formulated. Such criteria were developed however, for the extension of the project into 1966. From a total of 63 proposals that were submitted, 23 grants were awarded. One grant was divided into four parts and awarded to four persons, and one grant was also divided among four librarians for producing one total library program. Two larger grants for half time programing on a year long basis were also made.

The letter to programers regarding the terms of the agreement contains the following:

The terms of the agreement are as follows: you will work for a period of nine weeks during the summer of 1964, including attendance at the training workshop which will be held in two sessions. The first session will be held during the week of June 15, and the second session will be held during the week of July 13. Your expenses will be paid to these workshops. During the seven remaining weeks you will work according to the general specifications of your proposal under the supervision of project personnel. At the end of the summer we are tentatively planning to hold a two day evaluation workshop. We will also wish you to attend that workshop, for

ur

OK

which your expenses will be paid.

For your work you will receive a stipend of two-ninths your annual salary to be paid at the conclusion of the summer. Up to $500 may be spent on materials and clerical help.

The recipients of the grants and the initial statement of their topics to be programed are listed below.

Programers	Department	Original Program Topic
Albion College		
James Cook	English	"The Craft of Poetic Criticism"
Antioch College		
Clarence Leuba	Psychology	"Cognates adjunctive to Man"
W. M. Lotkowski*	Geology	"Programed Unit on Soils"
Lois Pelekoudas*	Political Science	"Procedures of Systematic Analysis in Political Science"
Denison University		
Kenneth Marshall	English	"Formal Structure of the Short Story"
Morton Schagrin	Philosophy of Science	"The Language of Science"
DePauw University		
Preston Adams	Botany	"Gross and Microscopic Anatomy of the Green Plant"
Thomas Davis	Mathematics	"Conic Section, Polar Coordinates, the Line"
Frank McKenna	Psychology	"Concepts of Business and Industrial Psychology"
Fred Silander	Economics	"General Concept of a Theoretical Model"
Earlham College		
Robert Brewster	German	"Programed German Vocabulary through Cognates"
Ansell Gooding	Geology	"Self-instruction Materials for Geology"
Wm. Stephenson	Biology	"Biochemistry for General Biology Course"
Hope College		
Phillip Van Eyl	Psychology	"Techniques of Reading Technical Articles"

---

*Half-time grants of year-long duration.

Programers	Department	Original Program Topic
Kalamazoo College		
Lawrence Smith	Music	"Ear-training in Music"
Kenyon College		
Paul Schwartz	Music	"Musical Notation and Terminology"
Oberlin College		
Peter Hawkins	Chemistry	"Selected Organic Chemistry Concepts"
Forbes Whiteside	Art	"The Nature and Uses of Color"
Ohio Wesleyan Univeristy		
Robert Montgomery	Religion	"The Synoptic Problem"
Vant Kebker	Economics	"Capital Budgeting"
Joseph Wetmore	Education	"Public School Finance"
Wabash College		
Richard Strawn	French	"Structure of French"
Wooster College		
Richard Knudten	Sociology	"Social Organization"
Library Grants		
J. McRee Elrod	Ohio Wesleyan	"Preparing a Unit Card"
Evan Farber	Earlham	"Organization and Terminology"
Peter Kidder	Kenyon	"Ordering LC Cards"
Marian Mullendor	DePauw	
Fractional Grants		
Guy Stern		"Adaptation of German Textbooks"
Wolf- Malott		"Absolute Pitch Training"
James Cope		"Associating Bird songs with Bird Pictures"
Paul Arnold		"Print Making"

Third Liaison Committee Meeting

The Third Liaison Committee meeting was held on May 8, 1964 at the Indianapolis Airport Hotel. Committee members reviewed activities at the colleges by means of a chart showing the number of contacts, proposals received, participants at work conferences and awards granted. After discussing the quarterly report to the Office of Education, the difficulty of defining areas for programing and of setting up behavioral objectives, and after adopting the principle of evaluating a few programs in depth rather than many superficially, the committee formulated plans for a series of campus

OK

visits by the Director to display commercial programed materials thereby to recruit faculty persons to evaluate some of them. Two questions in evaluating commercial programed materials were to be asked: 1) Does programed material actually teach? and 2) how do you use programed material? The Director was instructed to call in a consultant to advise about processing evaluation data with a computer.

d

The Liaison Committee also discussed briefly the possibility of systematically evaluating GLCA produced programs at a later date.

Visits to GLCA Colleges to Display Commercial Programed Materials

The itinerary of the Director's visits to display commercial programed materials in the spring of 1964 was as follows:

May 14	Hope College	May 25	Oberlin College
May 15	Kalamazoo College	May 26	College of Wooster
May 19	Wabash College	May 27	Ohio Wesleyan University
May 20	Earlham College	May 28	Denison University
May 21	Antioch College	May 29	De Pauw University
May 22	Albion College		

A less propitious time could hardly be imagined for this visit to the colleges to exhibit commercial programmed materials. In many of the colleges comprehensive examinations and/or final examinations were being given. Professors were in the throes of grading papers. Generally speaking,few were in a mood even to walk across campus to examine the materials. Approximately 90 persons in 11 colleges inspected the programs with various degrees of seriousness.[7] More important than the number of persons who inspected the programs, however, was the number of those who expressed interest in testing programs. Eighteen individuals made more or less firm commitments to test a program. Fifteen of these persons did actually test a program during the fall and winter of 1964, of which about a dozen were able to report results.

Summer Training Workshop, 1964

The major activities during the summer of 1964 were the preparations of programed material and the two week training period which all programers received. Conducted by the University of Michigan at Fairlane Estate, Dearborn, Michigan, the training centered on the process of programing. About this time it became apparent that the training in programing might be effective not only in producing high quality programed material, but also in making a significant impact on teaching in GLCA colleges. In addition, if the summer programing were to be continued for several summers, a significant pool of trained programers would be formed in GLCA colleges.

---

[7] See Appendix A-11.

The workshop was divided into two sessions, the first running from Sunday evening, June 14, through Friday Afternoon, June 19, 1964 and the second session from Sunday evening, July 12, through Friday afternoon, July 19, 1964. The number of Great Lakes Colleges Association participants did not exceed 24, and the GLCA staff did not exceed two.

The first session of the workshop was devoted to training the participants in the rudiments of programing. The second session was concerned with editing, evaluating and managing programs. Between sessions the participants worked on their own campuses and returned to the second session with in-progress programs. The details of the workshop program were worked out with the director of the workshop, who was designated by the University, with his staff, and with the director of the Programed Instruction Project.[8]

The workshop staff consisted of a Director, a liaison administrator, and program editors furnished by the University. The workshop was conducted on about a four-to-one student-faculty ratio.

Principles of Training

The principles of training under which the workshop was conducted are stated below and elaborated in Chapter 6.

1. The process of programing depends upon an analysis of the subject matter, and is not to be governed by preconceived ideas about the mechanics and "proper" format, e.g., linear, branching, small or large steps, or immediate reinforcement.
    a. By analysis of subject matter is meant the formulation of objectives in behavioral terms, determination of criterion frames, and the construction of the fewest number of teaching frames to bring the student to the behaviors required by the objectives.

    b. Pre and post-tests are integral parts of the analysis of the subject matter since they provide evidence of the student's achievement of the objectives.

---

[8] For a schedule of the workshop, see Appendix A-12.

2. Learning perceptual and conceptual discrimination by discovery is often more effective than is "shaping of behavior" by reinforcement. Discovery is generally initiated by the presentation of a problem or a panel of data about which questions are asked of the subject. The process of discovering the answer produces the desired behaviors, which may then be practiced with further examples or may be tested later in the post-test.

    a. If the subject makes errors, it is desirable first to ascertain whether the errors interfere with the student's learning and, secondly, whether the material is clearly presented. If material is unclear or ambiguous, steps are taken to rectify the sequence of presentation or to state the matter more precisely. More frames are not necessarily added just to prevent errors from being made.

    b. Emphasis is placed on producing meaningful, thoughtful responses from the subject, as opposed to the almost meaningless or rote responses that are frequently found to be required in some programs.

    c. The results are "lean" programs rather than the redundant ones so often found on the market at the present time.

3. Programs need to be validated empirically to ascertain whether they teach what the author claims they will teach in his statement of objectives.

    a. Test subjects need to be available from the earliest stages of program writing.

    b. Test subjects can also be used to discover whether the program is appropriate for the intended audience. For example, if test subjects can successfully do all criterion frames before working through the program, there is no need to write the program since they already know all it has to teach.

Training Personnel

The following persons were involved in the training workshop at the University of Michigan: Mr. Dale M. Brethower, an editor, is a psychologist and assistant director of "ALLP", a language programming project sponsored by the Office of Education and directed by Professor F. Rand Morton.

Dr. George L. Geis, director of the workshop, is a Research Associate in the University of Michigan's Center for Research on Learning and Teaching.

Dr. Patricia O'Conner, an editor, is a Research Associate in the Center for Research on Learning and Teaching and a lecturer in the Department of Psychology at the University of Michigan.

Mr. Geary A. Rummler, editor, is Director of the Center for Programed Learning for Business in the Bureau of Inductrial Relations at the University of Michigan.

Mr. Albert W. Schrader, III, editor, is Publications Director of the University of Michigan's Bureau of Industrial Relations and a Consultant to the Center for Programed Learning for Business.

Dr. Donald E. P. Smith, part-time editor, Chief of Reading Improvement Services, Bureau of Pyschological Services and Associate Professor of Education at the University of Michigan first came to the University of Michigan in 1952.

Dr. M. Daniel Smith, an editor from GLCA, is an Assistant Professor in Education at Earlham College.

Evaluation of Summer Workshops

Participants in the Summer Training Workshops returned thoughtful evaluations of the sessions. Nearly everyone said it had been helpful or worthwhile to their program writing experience.

- workshop was very helpful. If its main objective was to get me writing frames, then that was accomplished.
- tremendous surge of work on third and fourth days, good morale, team research.
- liked the approach. . . using programing techniques to teach programing.
- didn't realize how valuable until I returned home and started to work. All GLCA people should go through this in small groups.

Individual consultations with editors were of most value to participants, and many mentioned that more time spent in this way would have been helpful.

- writing of frames in presence of experts and being able to check with them were most valuable parts of workshop.

OK

- would have liked four days of concentrated work with editorial conferences in late afternoons.
- helpful was presence of editors who have--despite their youth--had sound practical experience in programing.
- conversations with Geis, Stephenson, Gooding helped me clear ideas of my objectives.
- progress came through the work I did, during talks with editors.

Several persons suggested that the last day, Friday, made the session too long, and several others indicated that there were too many general presentations.

- most of talks and lectures hindered my progress . . needed to work alone.
- efforts interrupted by taping session.
- prefer lecture-discussions held at earliest or latest times so they would not interfere with programing work.

A half dozen persons said they would have liked more undisturbed time for frame writing. Most participants would have liked more time with individual editors and some kind of signup system so that everyone would have seen an editor several times. There were sharply differing opinions on the value of lectures.

- especially helpful was Don Smith's demonstration of principle that discrimination precedes synthesis. in
- the variety of methods and insights into learning theory were the most valuable things I learned.
- speech by Don Smith on reading program he wrote helped me see how program can be tested and revised. d
- liked the Markel movies, Geis on Retention; slowed by some speeches.
- lectures kept me from my program.
- without extra lectures could have gone home on Thursday.

Especially during the second workshop, several persons who had begun to make real progress in frame writing found lectures and discussion distracting. A few found the change of pace in lectures invigorating complete

and pertinent to the broad concept of teaching.

The Director and GLCA consulting editor Daniel Smith felt that the workshops had been competently handled by the University of Michigan group, that programers were helped with their program writing and their understanding of behavioral objectives for programs and for other courses as well. The physical setup of the workshop was a little unwieldy, and too much time was spent traveling between motel and meeting place. They agreed that another such workshop should be conducted at a motel in which conferences could be held in individual rooms, with editors' time made available on a signup basis and with each programer seeing an editor at least twice each day. Any lectures like those on EGRUL-RULEG should be introduced early in the program.[9] A brochure or a workbook which included excerpts from college level programs would be especially helpful, especially since the practicum supplied by the University staff did not include subject matter germane to the college level.

Below is a list of programs produced in the summer, 1964:

ANATOMY OF THE PLANT by Preston Adams
Department of Botany and Bacteriology, DeBauw University

GERMAN VOCABULARY LEARNING THROUGH COGNATES by Robert Brewster
Department of Languages, Earlham College

POETRY: METHOD AND MEANING by James Cook
Department of English, Albion College

ANALYTIC GEOMETRY by Thomas A. Davis
Department of Mathematics, DePauw University

PROGRAM ON CRYSTAL STRUCTURE by Ansel M. Gooding
Department of Geology and Soil Science, Earlham College

A SELECTED INTRODUCTORY ORGANIC CHEMISTRY by Peter J. Hawkins
Department of Chemistry, Oberlin College

CAPITAL BUDGETING by Vant W. Kebker
Department of Economics, Ohio Wesleyan University

A PROGRAM TO SELF-INSTRUCTION SOCIAL ORGANIZATION by Richard Knudten
Department of Sociology, College of Wooster

HUMAN NATURE by Clarence Leuba
Department of Psychology, Antioch College

9

---

[9] EGRUL-RULEG simply means presenting material by first providing students with examples(egs), from which he generalizes the rule (rul) or conversely, presenting rules followed by examples. Egrûl presentation seems most effective.

be[illegible] Correct this page pri[illegible] To be re[illegible]

PROGRAMMED UNIT ON SOILS by William Lotkowski
Department of Earth Sciences, Antioch College

THE FORMAL STRUCTURE OF THE SHORT STORY by Kenneth B. Marshall
Department of English, Denison University

SELECTION PROCEDURES by Frank S. McKenna
Department of Psychology, DePauw University

THE TWO-SOURCE THEORY ABOUT THE SYNOPTIC PROBLEM by Robert Montgomery
Department of Religion, Ohio Wesleyan University

PROCEDURES OF SYSTEMATIC ANALYSIS IN POLITICAL SCIENCE by Lois Pelekoudas
Department of Political Science, Antioch College

THE LANGUAGE OF LOGIC by Morton Schagrin
Department of Physical Science, Denison University

MUSICAL SCORE READING by Paul Schwartz
Department of Music, Kenyon College

INTRODUCTION TO THEORY AND INTRODUCTION TO THE SUBJECT MATTER OF ECONOMICS
by Fred S. Silander, Department of Economics, Pauw University

EAR TRAINING by L. Smith, H. Ray and R. Hammar
Department of Music, Kalamazoo College

BIOCHEMISTRY FOR GENERAL BIOLOGY by William K. Stephenson
Department of Biology, Earlham College

HOW TO STUDY A TEXTBOOK by Phillip Van Eyl
Department of Psychology, Hope College

FINANCING OUR PUBLIC SCHOOLS by Joseph N. Wetmore
Department of Education, Ohio Wesleyan University

DISCRIMINATION IN HUE, VALUE AND INTENSITY by Forbes Whiteside
Department of Art, Oberlin College

A grant was also made to four librarians, each of whom was to prepare a quarter of the program. The program is designed to train newly acquired library personnel to become proficient in the routine tasks in library science that they would be required to perform. The programers are Mr. J. McRee Elrod, Ohio Wesleyan University; Miss Marian Mulendore, DePauw University; Mr. Peter Kidder, Kenyon College; and Mr. Evan Farber, Earlham College.

Four fractional grants were also made for small projects. Professor Paul Arnold, Art Department, Oberlin College, received a small grant to produce a series of very brief films on intaglio printing techniques; Professor James Cope, Biology Department, Earlham College, received a grant to make tape recordings of bird calls to be associated with colored slides of birds; Professors Irvin Wolf and Malott in the Psychology Department at Denison University received a grant to experiment with procedures for training absolute pitch; Professor Guy Stern, formerly of the German Department of Denison University, received a grant to adapt an already existing series of small German textbooks to programed learning and self-instruction.

Survey of Use of Programed Instruction

In December 1964 a brief survey was made of the use of programed instructional materials during that semester in GLCA colleges. A total of 70 programs were reported being used by more than 3,000 students: Ten programs in biology, 11 in chemistry, four in education, five in economics, six in English, three in geology, 12 in mathematics, three in modern foreign languages, five in music, one in physical education, one inphysics, eight in psychology, one in religion.
See Appendix A-14 for more details of the survey.

Survey of Use of Programed Instruction

In December 1964 a brief survey was made of the use of programed instructional materials during that semester in GLCA colleges. A total of 70 programs were reported being used by more than 3,000 students: Ten programs in biology, 11 in chemistry, four in education, five in economics, six in English, three in geology, 12 in mathematics, three in modern foreign languages, five in music, one in physical education, one in physics, eight in psychology, one in religion. See Appendix A-14 for more details of the survey.

OK

Chapter 2

THE SECOND AND THIRD YEARS

Evaluation of Commercial Programs

During the last two weeks of May, 1964, the Director visited the GLCA colleges to display the commercial programs that he had accumulated during the previous nine months as described in Chapter 1. About 18 persons indicated interest in trying out one or two programs each the following Fall. The Liaison Committee in the Spring 1964 meeting had decided that the programs to be evaluated should be tested in the most rigorous manner possible. The experimental design included carefully matched control groups, comparisons of programs with other media or with traditional teaching techniques, and pre-and post-testing.

During the summer of 1964 twelve instructors agreed to test commercial programs. Later three more instructors were found. The Director helped each of the fifteen think through the initial process of evaluation during the late summer and early fall. The designs might be categorized as "field experiments" in the terminology of Cartwright and Zander (*Group Dynamics*, 1960, pp. 51-52). The actual evaluation took place during the school year 1964-65.

In addition to control and experimental groups and relatively controlled variables, each experiment employed four common instruments:

1. a student evaluation list form for the experimental group
2. a student evaluation form for the control group
3. an instructor evaluation form
4. a personnel data roster form

These instruments provided some standardization for the evaluation. But the evaluations were far less adequately controlled than had been planned. A more complete report of the process and results of evaluating commercial programs is given in Chapter 5.

Field Testing GLCA - Prepared Programs

Two kinds of testing are used in the preparation of programed instructional material. The first may be called developmental testing, the second field testing.

Developmental testing is done very early in the preparation of the material. As its name suggests its purpose is to test the program while it is being developed. It is generally done on a one-to-one basis, the programer presenting his program frames on cards, one card at a time, to a student or a series of students acting as test subjects. The difficulties and misconceptions as well as successful completion of teaching frames are noted by the programer, who observes the student to see where he hesitates, what misunderstandings he has, and what is clear to him.

After the student has completed the segment of the program presented to him, the programer discusses his observations with the student to obtain as much information as possible from the testing situation. The programer then reviews and rewrites his program in the light of the comments made by the test subjects. The programer may submit his program to similar on-the-spot testing many times in the course of developing the program.

Field testing serves a different purpose. It is largely a test of the instructions for administering the program and a test of how well the program teaches under the conditions in which it will be used in the "field." The instructor who field tests the program is asked to evaluate it. The student is given a questionnaire about his response to the program and also makes notes on the program as he goes through it. Occasionally a perceptive student will give as much information on a field test as previous students did on a development test, but usually the information obtained is more general.

Field testing which was conducted during the fall of 1964 was an integral part of producing programed material on this project. For each field tester the programer furnished a sufficient number of copies of the program, sufficient pre-and-post tests, and instructions to the faculty person administering the program and to the students taking it.

The Programed Instruction Project made it possible for the program writer to do some additional indirect assessment of the effectiveness of the program with instruments provided by the project office. Below are listed the instruments and instructions that were supplied to each field tester to administer:

1. Instructor Program Evaluation Questionnaire: To be completed by the instructor during and after the program has been completed by the students. It will record your evaluative comments on the program.[10]

---

[10] For samples of the actual instruments See Appendices B-1 and B-2.

OK

2. Student Evaluation Questionnaire: To be given to students after they have completed the program to obtain their reaction and evaluative comments on the program.[10]

3. Student Personnel Data Roster Form: To be used to collect such data as the students' scholastic aptitude test scores, their rank in their graduating class in high school, etc.

4. Time Sheets: (optional) to be filled in by students at the conclusion of their work indicating how much time they used to work on the program.

5. Instructions for administering the above instruments in field testing are as follows:

   a. Give students pre-test on material to be covered by the program.

   b. Hand out programs to students within a day after pre-test with instructions and time sheets.

   c. Give students designated amount of time to complete programs.

   d. Collect completed programs and time sheets from students.

   e. Give students post-test within a day or so of their completing the program.

   f. Give students the Student Evaluation Questionnaire within a day or so of their having completed the post-test.

   g. Fill out of the Instructor Program Evaluation. You may wish to start to record your reactions while the students are still working on the programs.

   h. Ship programs, pre-and post-tests, student questionnaires, time sheets, instructors questionnaires, back to the programer who will handle the data from that point.

About processing field test data Dr. Daniel Smith made the following suggestions. Data from field tests are usually of such quantity that they tell the program writer more than he can assimilate about the program. The task is to sample the data selectively,

---

[10] For samples of the actual instruments See Appendices B-1 and B-2.

OK

and then to examine particular questions using a more extensive sample if it seems warranted. Therefore, I would suggest that the program responses be divided into three categories: top students, average students, and low students. This can be done on the basis of combined grades and SAT scores to be obtained from the Personnel Data Roster. Then I would suggest that three students be selected at random from each level from each campus, their program responses and pre-post-test responses be examined in detail. Keep a record of hypotheses concerning the program growing from this examination.

A count of errors, as well as pre-and post-test scores and gain scores, should be kept for the students of the sample at each level and for each campus; this will make it possible to draw some broad conclusions of a comparative nature across all programs (thus names of students should be entered along with the data).

For purposes of revision, on the other hand, such data are less important than the hypotheses the programer forms by considering the nature of the errors. The fact that errors have been made on a particular item will not necessarily imply that a revision of that item is necessary; it may imply instead a revision of certain prior frames or sequences of frames. Indeed, the nature of errors will be only one of several factors considered in revising: other factors will be the experience of the programer in programing, the feedback coming from editors, and feedback from subject matter experts who reviewed the programs. Of course, there will be some cases where one will want to examine a larger number of cases in order to determine more accurately the nature and extent of erroneous conclusions on a particular item or set of items. With these instructions and suggestions in mind, GLCA faculty members field tested programs at their several institutions.[11] Programmers examined the results thus obtained, and, in light of them, many revised their programs.

Fourth Liaison Committee Meeting

The fourth Liaison Committee Meeting was held at the Airways Motel in Columbus Ohio on April 2, 1965. All of the colleges except Wabash were represented.

The first item for discussion was means for improving the production and field testing of programs for 1965. The committee decided to have the grant period run to April, 1966, since most programers' work would extend more than six months beyond the summer. They also decided to ask for an outline of material before the June workshop so that each programer would be ready to work toward a statement of objectives during the workshop. Another decision made was to begin securing field testers and consultants to help programers.

---

[11] For a list of programers and field testers. see Appendix B-3.

One of the project's most difficult problems involved conducting the evaluation of the GLCA -produced programs during the Fall of 1965. The suggested outline of Evaluation of Programed Instruction with its 10 categories as presented to the Committee by the Director proved to be too unwieldy, and the committee spent a long time discussing other types of evaluation. One suggestion was that using programs as a substitute for lectures be tried out as the only condition, but varied under a number of teaching situations. Any professor who agreed to evaluate the programs would be expected to commit himself for a period of two weeks in which he would teach the course and use the program according to the evaluation design. There was a strong concensus that as many controls as possible be applied. Finally, the conferees decided to set up a research design committee to formulate an overall evaluation plan. The designs drawn from the overall plan would be used by the Director to recruit GLCA faculty members to do the evaluation. The Director would then work with these faculty persons to refine a particular design, fitting both the overall evaluation plan and the instructors' teaching situation. An evaluation conference was planned for September, 1965 to provide all the program evaluators brief but intensive training in the process of evaluation. Evaluation of GLCA-produced programs is described in Chapter 6.

The committee also set up the following series of deadlines.

1. First programing workshop, June 14-16
2. Second programing workshop, July 12-14
3. Research workshop September 1965 for evaluation of GLCA-1964 programs
4. Early Spring, 1966, Liaison Committee
5. Late Spring, 1966, Final Reporting Conference

Second Round of Program Writing

For the second round of programing in 1965, an administrative procedure similar to that of 1964 was used without, however, having a Winter Work Conference to generate proposals and enthusiasm for writing programs. During the Winter of 1965, the Director interviewed prospective programers on their campuses leaving application forms with them. A selection panel consisting of Drs. Loche Van Atta, Daniel Smith, Donald Beane, and the Director selected the program applications that seemed most promising.

The criteria used in selecting proposals for programs to be written in the Summer, 1965, were as follows:

1. Does the proposal give evidence that the person has a clear, concise idea of the content of what he wants to program?
2. Does the description of the program give evidence that the person has a clear, concise idea of the process of programing?
3. Is the scope of the material to be programed sufficiently delimited?
4. Does the person give evidence of having selected material which is programable and which can be handled by a program better than by some other instructional means?

Interestingly enough only about 30 applications were received as opposed to sixty the year before. Twelve were selected.

The method of selection used both in 1964 and 1965 had one weakness, namely, there was no panel of content specialists to evaluate the content of the application for programing. The selection panel consisted of men who were experts in programing but not in each subject matter area. The same general agreement between programers and Project were in effect as in 1964.

The concept of the team was developed more fully in the second round of programing in 1965. In this procedure content specialists early consulted with the programers. However, even at this point it was probably too late. Sympathetic content specialists should probably sit down at the time of the programer's writing of the proposal in order to give him help at the very beginning.

In response to a question asking: "Do you have any suggestions for improving the effectiveness of content editing?" two of the 1965 programers said the following:

- - The most efficient way to use content editors would have been to let them look over the subject matter outline before starting to write the program at all.
- - Content editors should be required to sit down with the programer and go over the material step by step.

The idea of a team of scholars from a given discipline drawing up a proposal for a program was set up as one of the goals in the contract. The goal was not reached. The kind of cooperation implicit in such a goal requires a high level of cooperation that does not presently seem possible in GLCA.

First Session Summer Workshop, 1965.

The first session of the summer programing workshop was held at Indianapolis Airport Hotel, June 14 - 16. The entire session was devoted to the writing of behavioral objectives, criterion frames, and teaching frames. [12]

Four group meetings were held as follows: Monday afternoon Dr. Daniel Smith talked about the process of programing and concept formation. Later Dr. Morton Shagrin was the moderator of a brainstorming session in which the various problems of the programers were discussed, particularly the writing of behavioral objectives and criterion frames. On Monday evening the film "Programed Instruction: Developmental Process" was shown and discussed. Three presentations was too much for one day; the brainstorming session might have better been left out.

On Tuesday a group session was led by Dr. William Stephenson on the "eg-rul" process of frame writing. (See Chapter 7) Dr. James Cook also handed out a program on "Developmental Testing." On Wednesday Dr. Cook continued with the "Developmental Testing" program. No more group meetings were held.

Second Session Summer Workshop, 1965.

The second session was held again in the Indianapolis Airport Hotel on July 12-14. On Sunday, July 11, briefing session was held at which time all the editors were present along with Dr. Donald Smith and Mr. George Geis from the University of Michigan.

On Monday morning the editors, including Smith and Geis, worked with the programers as soon as they came in. The editing continued throughout the day. The programers were preparing to test their programs on student subjects from Butler University.

---

[12] For the agenda of the First Training Workshop Summer, 1965 see Appendix B-4.

Throughout the morning on Tuesday there was continued editing activity with the four GLCA editors. By one o'clock the students from Butler University were on hand and were assigned to the programers, each programer working with one student for a period of an hour and a half.

Programers varied in their openness to the responses the students made to their programs. One programer, for example, kept adding verbal instructions to his program and learned practically nothing from the student's response to what his program conveyed. Two others were very sensitive and perceptive to places where the students seemed to bog down.

The GLCA editors held a discussion with programers between their sessions with the test subjects. The editors pointed out to the programers the deficiencies in their approach. It was noted, for example, that when a student makes a mistake and a programer says, "You were wrong there, weren't you?" it is likely to inhibit the student from giving further information. If, however, the programer had said at that point, "The program was not very clear at that point, was it?" he would elicit much more information from the student about the program.

On Tuesday evening Drs. James Cook and Morton Schagrin led a discussion on questions raised in the developmental testing.

On Wednesday the group met, and the programers were given 4 x 6 cards on which they were tentatively to describe their programs. The group then discussed handling the content editors and the program. The programers were asked what questions they wanted the content editors to answer. The programers suggested a number of questions which the director put into a memo form and sent out to them a couple of weeks after the workshop.

The group then discussed what programing could teach them about teaching in general. Their main observation was that the setting up of objectives was an extremely important and valuable lesson for teaching in general. They did not, however, discuss the importance of empirically testing what they wanted to teach. Neither did they talk about the importance of analyzing the subject matter in terms of the task that the student has to perform on it. The rest of Wednesday was spent in writing frames, reviewing what they had done with students, and editing. The conference closed at 5 o'clock.

Evaluation of Summer Workshops, 1965

The twelve programers who participated in the Summer Workshops in June and July of 1965 evaluated the two three day workshops on a questionnaire they received at the workshops. Their evaluations are summarized below, with excerpts from several of them. The same questionnaire was given each time.

Asked for a general evaluation of the workshop, everyone stated that it had been valuable, a good experience, or useful. Eight of the twelve mentioned the thoughtful and experienced assistance they received from the GLCA editors, who themselves had written programs during the 1964 summer. Another four mentioned the value of having editors right at hand and available to them, and three mentioned the value of having several editors with differing strengths and approaches.

- - The editors guided without dominating.

- - Most valuable . . . was "instant editors" available day and evening.

- - My editor was both critical and encouraging.

Several programers mentioned the informative general sessions, the helpfulness of presentation as well as editing of Dr. Daniel Smith, the value of having had enough time for individual work in writing programs. Two of the programers felt that a three day workshop was too long, and three persons felt that work was broken up with general presentations.

- - Presentation of constructing terminal frames was helpful.

- - Egrul and Ruleg concepts have been helpful.

- - Formal sessions, by and large, were good. Some of them seemed to break up progress I thought I was making in frame writing.

- - Basic sequence of topics was good.

The answers to this same question after the second workshop were similar, but were uniformly more certain both in commendation and criticism. Again, most programers mentioned the value of having editors on hand. Half of them mentioned the value of the Tuesday afternoon session with test subjects and the following discussion. Several mentioned the value of outside expert Dr. Donald Smith from the University of Michigan. Three persons indicated receiving help from the general sessions, one mentioning he would have liked more of these. Two programers, however, would have liked more individual working time.

OK

- - Being able to consult with four editors was invaluable, as was the opportunity to test.

- - I liked being able to take a question to a number of people.

- - Useful, particularly the testing session.

- - Proportion of time spent on talks and individual work was better than first session.

A second question asked: What new insights or understandings of programing occurred to you during and since the workshop? What slowed you down or held up progress?

Answers to this question after the first workshop were varied. Two persons mentioned skills gained in writing a program rather than a textbook. Several mentioned insight into making clear objectives, and another person added the ability to put objectives into operational terms. Five of the programers referred to skill gained in understanding how a student learns as over against how a teacher teaches. Half of the programers mentioned insight into some programing technique: writing criterion frames, terminal frames, or discrimination.

- - I realized more clearly the relevance of making an explicit statement of objectives and difficulty of making a workable one.

- - I soon learned to stop trying to write a textbook and begin a program.

- - I saw relationship of techniques to problems.

- - I was held back on a content problem, i.e., had chosen too large an objective. Breakthrough came when I discovered an interim method by which it could be solved.

- - Helpful to begin with construction of terminal frames.

- - Objectives set by ardent exponents of programing are too ambitious.

- - I've grown to appreciate the plight of the student.

- - Criterion after frames as a method have helped a lot.

After the second workshop this question was answered more in terms of progress on particular programs than in general insights into programing or in teaching and learning.

- - After the second workshop I rewrote the entire program.

- - I observed how differently the two girls I tested set out their work, and the difficulty of accommodating a broad range of ability.

- - Most valuable suggestions were those concerning use of discrimination and those on format.

- - Disappointed with editorial help. Some of it seemed contradictory or at best tangential. This was likely, however, because of the specialized nature of my project.

- - Discrimination frames was greatest revelation to me.

Below is a list of programs produced in the summer, 1965

A PROGRAM IN COMPOSITION by Fred Bergman
Department of English, DePauw University

MAKING SENSE OF EXPERIENCE by Owen Duston
Department of English, Wabash College

FREEDOM VS. FREEDOM by Robert B. Fichter
Department of Religion, Ohio Wesleyan University

PASO A PASO by Renato J. Gonzales
Department of Spanish, Albion College

ALTERNATIVE LOGICS by L. H. Hackstaff
Department of Philosophy, Wabash College

LABORATORY SUPPLEMENT FOR CHEMISTRY 11 and 12 by Alfred Henderson and
Laurence Strong, Department of Chemistry, Earlham College

MUSICAL RHYTHM by Leonard C. Holvik
Department of Music, Earlham College

POLITICAL DISPOSITION OF ADMINISTRATION by William L. Morrow
Department of Political Science, DePauw University

AN INTRODUCTION TO MODERN PHYSICS by B. R. Russell
Department of Physics, College of Wooster

A PROGRAMED REFERENCE GRAMMAR OF ELEMENTARY FOR SPOKEN AND WRITTEN
by Richard Strawn, Department of Romance Languages, FRENCH
Wabash College

ELECTROPHYSIOLOGY OF NERVOUS TISSUE by Francis W. Yow
Department of Biology, Kenyon College

CRYSTALS: AN INTRODUCTION - A PROGRAMED LABORATORY AND INDEPENDENT STUDY UNIT
by John White, Department of Earth Sciences, Antioch College

Field Testing 1965 Programs

The extension of the contract called for a conference to be held in September, 1965, for the programers and the persons who were to field test their programs. However, because every programer was at a different stage in the development of his program at the end of summer and because there was such a wide variety of programs being produced some of which used other media besides straight verbal material, it was not considered desirable to hold one field testing conference. There was very little that the programers had in common that would warrant such a meeting. Instead each programer was authorized to meet with two field testers and to review with them the procedures for field testing at a time and place convenient to both programers and field testers.

The Director supplied the programers with sufficient numbers of Student Evaluation Questionnaires and forms for collecting data on the students who took the program in the field test as well as field testing directions. The programers were given the responsibility of distributing these materials to their field testers themselves.

Evaluation of 1964 GLCA produced programs

The extension of the contract called for the evaluation and comparison of the use of programed instructional materials prepared in 1964 in as great a variety of instructional situations as possible. In the fourth Liaison Committee meeting held on April 2, 1965 the decision had been made to evaluate the 1964 GLCA produced programs under conditions that were as controlled as possible. According to that decision a small number of programs would be evaluated under a limited number of well controlled conditions rather than having a large number of programs tested under a large number of poorly controlled conditions.

The process of selecting programs to be evaluated was as follows: A selection panel consisting of Professor Celeste Mc Collough from Oberlin College and Dr. Daniel Smith from Earlham College along with the director inspected all of the programs that were produced in 1964 and made a selection of five programs that they considered to be the best suited for evaluation. The major criterion of selection was the excellence of the program.

In addition, however, an attempt was made to represent all of the major areas of a liberal arts curriculum- the natural sciences, the social sciences, and the humanities.

The following programs were selected:

1. POETRY: METHOD AND MEANING, by James W. Cook, Department of English, Albion College
2. LANGUAGE OF LOGIC, by Morton Schagrin, Department of History of Sciences, Denison University
3. BIOCHEMISTRY FOR BIOLOGISTS, by William K. Stephenson, Department of Biology, Earlham College
4. STUDIES IN THE GOSPELS, by Robert Montgomery, Department of Religion, Ohio Wesleyan University
5. AN INTRODUCTION TO SYSTEMATIC ANALYSIS IN POLITICAL SCIENCE, by Lois M. Pelekoudas, Department of Political Science, Antioch College.

The programs are described in detail and sample pages displayed in Chapter 3.

In the spring of 1965 the Director visited each of the twelve GLCA colleges to display all of the GLCA programs that were produced in the summer of 1964. The purpose was to recruit faculty members to evaluate the selected GLCA programs. The Director prepared a memorandum to prospective evaluators of GLCA programs in Departments of English, Mathematics, Natural Science, Philosophy, Psychology, Biology, Religion and Economics, and Political Science (those departments into which the selected programs fit). The memorandum described the general basic question which the evaluation was designed to answer: How can programed materials be most effectively used in college teaching? Four specific questions were formulated to elaborate the basic question and to serve as the focus of the evaluation of the programs. They were described in the memorandum as follows:

1. Do programs teach as effectively as textbooks or lectures covering the same material?

2. What classroom activities such as discussion or lectures following the students' use of the program most effectively capitalizes on what the students have learned from the program?

3. Is the program more effective as an instrument for the acquisition of knowledge or information or as a device for reviewing information acquired earlier by some other methods?

4. What effect does intrinsic or extrinsic motivation have on learning by programed materials?

One additional question was asked, namely what characteristics of the students affect their learning via programed materials.

The memorandum also described requirements for prospective evaluators. Anyone desiring to evaluate one of the GLCA programs was expected to meet the following conditions:

1. Has access to 50-60 students during the first semester or term of 1965 in a course where the program to be evaluated can be used appropriately and where the students can be separated into relatively independent groups. For testing three or more conditions three or more groups will be needed.

2. Can give approximately 10 days to the evaluations and related activities during the first semester.

3. Will take responsibility for the collection of background data of students particpating in the experiment.

4. Will attend a two day research conference toward the end of the summer of 1965 at which time final arrangements for conducting the evaluations will be made.

5. Will attend a one day conference in winter or spring of 1966 at which time results of all evaluation projects will be reported out and discussed.

6. Will select in consultation with the coordinator and adhere to one of the evaluation designs.

Four evaluation designs were then described in the memorandum. Each of the evaluation designs approximated normal classroom situations and yet were set up to evaluate questions above which were pertinent to the teaching interest of GLCA faculty members and to their concerns about programed instruction. Chapter 6 contains a full and complete description of the evaluation designs.

For his services in conducting the evaluation the faculty member was offered a stipend of $500 plus funds for materials and clerical help in collecting data on students. It was anticipated that about ten days of the instructor's time would be required for the evaluation and all that pertains to it including conference time. It was also promised that the data would be processed by computer. The Computer Center at Kalamazoo College was used for this work.

Application forms for participating in evaluation of one of the programs were made available to interested faculty members and instructions were given to have them turned in by May 7, 1965 so that the Director could interview applicants when he visited the colleges. Eventually 28 instructors in eight GLCA colleges and one non-GLCA college agreed to evaluate the selected GLCA programs.

During the Summer of 1965 Professor Donald Beane, on leave of absence from the College of Wooster was selected as Evaluation Project Coordinator. He conferred with each of the evaluators except two who were off campus until early in September. He reviewed with the evaluators in detail the procedures they would be expected to follow in order to evaluate the program. Each evaluator was given a copy of the evaluation design spelling out in detail for each day of the evaluation what the instructor was expected to do. A sample Form of Evaluation Design is found in Appendix B-5. Although each Design contained the same general categories, the question to be answered and the details of the evaluation design differed from one evaluator to the next. In addition to receiving a copy of the evaluation design each of the evaluators also received a memorandum from the Coordinator describing the general responsibilities of all program evaluators. The memorandum describing the general responsibilities are found in Appendix B-6. By the end of the Summer of 1965 each evaluator had participated in a minimum of two individual conferences- one with the Director in the early spring or summer and/or one with the Coordinator later in the summer. All of the evaluators had gained a rather detailed understanding of what their evaluation procedures would be. Each evaluator retained a copy of his evaluation design and a copy was filed with the Coordiator and with the Director.

The following instruments were developed for the evaluation project:

1. Student Data Roster (See Appendix E-6)

2. Teaching-Method Evaluation Questionnaire (for students) (See Appendix E-6)

3. Instructor Program Evaluation Form (See Appendix B-1)

4. Each programer produced an equivalent set of pre and post test questions. See Appendices E-1 to E-5.

The Teaching Method Evaluation Questionnaire was developed out of instrument produced for the 1964 field testing of GLCA programs and the evaluation of commercial programs during the fall of 1964. The Instructor Program Evaluation Form is identical with the one developed for the evaluation of commercial programs in 1964.

On September 9 and 10 a Program Evaluation Training Conference was held at the Holiday Inn of Columbus Airport, Columbus, Ohio. On the final day of the conference DeHaan reported on the progress on the GLCA Programed Instruction Project. Dr. Donald Beane described the procedures for the fall evaluation of 1964 programs. In the afternoon of the first day the program evaluators met with the program authors to discuss the programs with them. Late in the afternoon the programs, tests, and questionnaires and other evaluation materials were distributed to the program evaluators. On the second morning of the conference Professor Morton Schagrin discussed the logic of research and evaluation of programs and Mr. William Jensen of the Computer Center of Kalamazoo talked about the computer treatment of data and its interpretation. The agenda of the program evaluation training conference is found in Appendix B-7.

In Appendix B-8 is a list of persons who attended the evaluators conference.

As a result of the discussions at the program evaluation training conference Dr. Donald Beane, coordinator of the evaluation project sent out a memo clarifying some points that required changes which all the evaluators were to observe. His memorandum is given in Appendix B-9.

On September 24, 1965 a conference on statistical treatment of the evaluation data that was held in Columbus, Ohio. Attending the conference were Drs. Robert DeHaan, Donald Beane, William Jansen, and Sam Cho. The latter is a member of the Psychology Department of the College of Wooster and served as a consultant on statistical questions in the handling of data.

Incidently it is worth noting the difficulty involved in trying to interest statistical consultants in problems of the GLCA evaluation project. The Director called on statistics specialists from Indiana University, Michigan State University, University of Pittsburgh, and Oberlin College. The consultants either claimed to be too specialized to be able to help or were over committed and could not take on any more work. As a result of the conference a detailed procedure for running an analysis of variance for each of the designs and the variables to be involved were agreed upon.

The rest of the first semester and the early part of the second semester was devoted to administering the evaluation designs. This was coordinated by Dr. Donald Beane. Results of the evaluation are reported in Chapter 6.

In this report stress has been laid on the actions taken by the Director and the Coordinator of the Evaluation Project to be as sure as possible that the evaluators knew what they were supposed to do before the evaluation got underway and then adhered rigidly to their instructions once the evaluation was started. If anything was learned from the evaluation of the commercial programs in 1964 it was that poorly conceived evaluation designs and incomplete data produced inconclusive and unsatisfactory results. In summary, the steps that were taken to assure interpretable and comparable results are as follows:

1. Use of the same program in four different evaluation designs.

2. Use of carefully prepared pre and post tests.

3. Two individual conferences between each evaluator and the program director or the coordinator of the evaluation project with some unavoidable exceptions.

4. A group conference on evaluation.

5. Agreement reached between the director and the coordinator about a detailed evaluation design including such things as how to score the pre and post tests, what instructions to give, how to introduce the program to the student.

6. Agreement reached on what data is to be collected and in what format it is to be recorded.

7. The use of common instruments to collect the instructor's evaluations the program and the students reaction to it.

Fifth Liaison Committee Meeting

The fifth Liaison Committee Meeting was held in the Holiday Inn, Columbus Airport on April 1, 1966 from noon until 5 P.M. All the colleges were represented except Oberlin and Wabash.

The committee received a preliminary report of the evaluation of 1964 GLCA programs from Dr. Donald Beane. The report included the results of the analysis of variance and a brief analysis of four of the most important questions on the student evaluation questionnaire. The committee responded by suggesting certain changes and additions to the report. The report will next be presented at the final evaluation conference on April 29.

The Director made a verbal report of the study of the impact of programing that he and Dr. Clarence Leuba are conducting. There were no results or conclusions, however, to be reported at this time.

The main item of business for the Liaison Committee was a review of the agenda of the Final Reporting Conference planned for April 29 and 30 in the Holiday Inn of Columbus Airport. The Liaison persons reported considerable difficulty in recruiting participants for the conference. One of the major difficulties is that the conference runs for a day and a half. For many of the college people this would involve being gone from home for two nights, the Thursday night preceeding the conference as well as the Friday night. Very few wanted to give up that much time for the conference. The discussion resulted in a recommendation that the conference be reduced from a one and a half day conference to a one day conference. The committee agreed that it would be better to pack one day full than to have a more loosely structured conference extending for a day and a half. After considerable discussion it was found that the agenda for the conference could be worked out on a one day basis.

The Liaison Committee also strongly recommended that each college send at least one member of the newly formed GLCA faculty council to participate in the final reporting conference. Since the Faculty Council will very likely be the body that recommends next steps to be taken on the project it was felt that as many members of the council as possible be on hand to hear the reports of how the project has been conducted for the past two and one half years. This recommendation was accepted readily by all the members of the Liaison Committee.

It was recommended that a small task force consisting of one representative from each college continue on through the Friday night of the final reporting conference and if necessary continue working until Saturday noon to formulate recommendations for the extension of the project. These recommendations would be addressed to the GLCA Board of Directors and to the Faculty Council. The task force would carry on the work of the conference which had originally been placed in the hands of the total conference. This suggestion of having a task force carry on was the major solution to making the conference a one day conference rather than one that went on for a day and a half.

Each Liaison person was given 10 copies of a preliminary draft of the Final Report of the Project to distribute among potential participants on his campus. In addition preliminary draft copies were sent to potential visitors from other small liberal arts colleges.

Final Reporting Conference

The Final Reporting Conference was convened on Friday, April 29, 1966 at the Holiday Inn, Columbus Airport, Ohio. The purposes of the Final Reporting Conference were two fold: To report out the results of the Programed Instruction Project and to develop plans for further study and improvement of instruction in the colleges comprising the Great Lakes Colleges Association. The final reporting conference was one of the major instruments for desseminating the the results of almost three years of work on the project.

Seventy persons attended the conference, fifty five of the participants came from eleven of the GLCA colleges. Ten visitors also attended the conference representing the Center for the Study of Higher Education, University of Michigan; Commission on Institutional Cooperation; Principia College, Elsah, Illinois; Center for Research on Learning and Teaching, University of Michigan; Associated Colleges of the Midwest; Lily Foundation; Calvin College; the University of Cincinnati. The conference staff and speakers consisted of Robert DeHaan, Director; Mrs. Robert DeHaan, Conference Secretary; Professor Clarence Leuba, Wright College Campus; Professor Donald Beane, College of Wooster; Dr. Eldon Johnson, President of GLCA. The list of conference participants and visitors found in Appendix B-10.

The conference displayed approximately two dozen programs that were produced in 1964 and 1965 under the auspices of the Programed Instruction Project. The display attracted a great deal of attention during the conference, partly because of the attractiveness of the display itself. Small cards identified the programs by title and author. Programs that had some visual aspects to them such as the art program or some auditory dimensions such as the music programs attracted the greatest amount of attention.

The agenda of the conference was divided roughly into two parts. The morning sessions were given over to reporting the results of the project; the afternoon was given to planning for further steps to be taken. (See Appendix B-11 for the complete conference agenda). The project Director, Robert DeHaan opened the conference by giving a brief outline of the purposes of the project and what it had accomplished to date. He covered some of the highlights that are found in Chapters 1, 2, and 3 of this report. He then introduced the first speaker of the morning, Dr. Donald G. Beane of the College of Wooster Coordinator of the evaluation studies of GLCA produced programs. His address was entitled Evaluation of GLCA Programs and covered essentially the same material that is given in Chapter 6 of this report.

The second report of the conference was made by Dr. Clarence Leuba on the topic Applications of the Principles Underlying Programed Instruction. His material is essentially what is found in Chapter 9 of this report.

The third presentation of the morning consisted of A Summary of Preliminary Recommendations by the Director. The material presented can be found in Chapters 3 and 10. The recommendations covered such things as further preparation of programed instructional materials, the use of preparing programed materials for inservice training of teachers continued research on teaching and learning the use of computers in the teaching-learning process, development of a centralized agency in GLCA for the improvement of learning and teaching.

After luncheon Dr. Eldon Johnson, President of the Great Lakes Colleges Association talked about the significance of the Project for the future. He reviewed the amount of cooperative effort that has gone into the Project and the high degree of involvement of those who had participated in it directly. He also showed, however, that the benefits of the project were not easy to disseminate. Those most highly involved received the greatest benefit; there was less carry-over of the effect to others than had been hoped for.

How to consolidate and spread the gains made on the Project is the first and one of the most important problems for our immediate consideration; secondly, we need to turn our attention to the problem of organizing ourselves for a continued attack on the problem of improving instruction; thirdly, the conference needs to recommend immediate action in the form of recommendations on how to proceed to solve the two problems above.

The rest of the afternoon was devoted to two rounds of discussion. In the first round the total conference group broke up into nine discussion groups in which the participants were randomly selected so that each discussion group contained members from different colleges. The purpose of the cross section discussion groups was to review the reports that had been made during the morning and to suggest as many ideas as possible for the extension of the project. The discussion leaders were given five questions to serve as guides to the discussion. The questions were as follows:

1. How can we communicate the results of the Project?

2. How can we interest colleagues in studying and improving teaching?

3. What guidelines or principles can be suggested for future developments in improving teaching and preparing teaching materials?

4. What specific recommendations or approaches hold the greatest promise?

5. What are other comments or suggestions for the future?

After the discussion groups had met for some time the total conference reconvened and reports were quickly made from each discussion group. The total conference then broke up into the second

OK

round of discussion. This time the discussion groups were organized by colleges. The purpose of the second round of discussion was to take the suggestions and ideas that had been brought forth in the first round, sort out the ones that would be the most useful on each campus and rank them in order of importance for each campus. After the discussion groups had spent an hour or so discussing the ideas they returned to the conference room where the recorder from each college reported on the ideas that had been discussed in the group.

The first set of ideas had to do with how to communicate the results of the Project on each local campus. One set of suggestions had to do with dissemination by means of brochures, professional journal articles, alumni magazines and pamphlets. The second set of ideas had to do with various kinds of meetings such as faculty meetings, AAUP meetings, demonstrations and exhibits.

Another large set of ideas centered around future developments for improving teaching and learning on the local campuses. The major ideas that appealed to the discussants were the development of a central agency or administration for the total Association and some experimentation with assisted computer instruction.

The conference adjourned at 5:30 and the remainder of the evening was given over to the work of the task force. The task force consisted of two representatives from each college. Their names are given in Appendix B-10. The task force assumed responsibility for summarizing the conference and indicating the direction in which new steps should be taken. It addressed itself to two groups, the GLCA Board of Directors and the GLCA Faculty Council.

The discussion centered around a number of topics that had been discussed during the course of the day. The possibility of setting up a teaching--learning center, consolidation of the work of the Project, developing facilities for computer assisted instruction. As the discussion progressed the group focused more and more upon the idea of a Center that would have as its purpose the involvement of the college in development and research on teaching. The discussion was brought sharply to a head with the suggestion that the Center be called a Center for Educational Development. The title captured the imagination of the task force. It contained a notion that the emphasis would be upon the development rather than upon research, that teaching would receive greater emphasis than learning.

The purposes in definition of the Center were outlined under four general headings: teaching, learning, media and dissemination. A list of activities were classified under each of these headings. The task force then reviewed the list of activities and underscored items that could be started up immediately or established as pilot projects.

The Director was instructed to summarize the discussion of the task force and to present to the Board of Directors of the Great Lakes Colleges Association a proposal for setting up a Center for Educational Development at their meeting on May 9, 1966. The Board of Directors would be requested to accept the report of the task force for information and to request that the Executive Committee of the Board be empowered to approve a more complete proposal when it is improved by the Faculty Council which was to meet May 18-21, 1966. The Faculty Council would be asked to approve the concept of the new Center in principle and to establish a committee to draw up a proposal on how such a Center could be financed and operated. The Faculty Council proposal would then be presented to the Board of Directors.

Recommendations Growing out of the Final Reporting Conference

The Director prepared a report on the Programed Instruction Project which was presented to the Board of Directors of the Great Lakes Colleges Association at its meeting on May 9, 1966. The report contained a general recommendation that the Great Lakes Colleges Association establish a Center for Educational Development. A specific recommendation was made that the Board of Directors receive the report for information and empower the Executive Committee to approve the establishment of a Center if the Faculty Council recommends it on May 18, 1966.

The Director presented a working paper on the Programed Instruction Project at the Faculty Council meeting on May 20, 1966. The following recommendations were presented to the council and were adopted.

1. That the Great Lakes Colleges Association establish a Center for Educational Development.

2. That the Faculty Council approve the appointment of a committee to study all pertinent phases of the establishment and operation of a Center.

3. That the committee prepare for submission to the Executive Committee of the Board of Directors of GLCA a proposal for the funding and operation of a Center.

Chapter 3

DESCRIPTION OF PROGRAMS PRODUCED ON THE PROJECT AND DEANS' EVALUATION OF THE PROJECT

A total of 34 programs were produced on the Project representing almost every department in a liberal arts college curriculum. In addition, a number of smaller programs dealing with library procedures was produced. Three other smaller programs were also developed two of which utilized 8mm film loops or audio tapes, and the third of which used already existing German readers. Combining the library programs into one program, and considering the latter three as one, it can be said that the Project produced 36 programs.

Detailed Description of Each Program

Below is a brief description of each program.[1]

TECHNICAL FILMS ON BASIC PRINTMAKING TECHNIQUES
Paul Arnold, Department of Art
Oberlin College, Oberlin, Ohio

General Objectives: To break down the basic techniques of intaglio printmaking into component steps, each of which is covered clearly and in detail in a loop film which can be projected easily by the student when he needs the information. The films eliminate the necessity for repeated individual explanations and demonstrations.

Courses for Which Intended: Problems in Printmaking

Topics Covered: All steps from preparation of plate through printing of impression

Approximate Time Required: Film loops used as needed

When and Where Field Tested: Oberlin College, second semester 64-65 by beginning students who entered class

---

[1] It was not possible to obtain descriptions from all the programers because some of them were out of the country, some had left GLCA colleges, or for other reasons were unavailable. In the 1964 group the following programers did not send in descriptions of the programs: Preston Adams, Ansell Gooding, Peter Hawkins, Richard Knudten, Fred Silander, Marian Mulendore.

Results of Field Test: Film loops accomplished the desired results. Only occasionally was it necessary to give students additional instruction.

GERMAN VOCABULARY THROUGH COGNATES
Robert Brewster, Department of German
Earlham College, Richmond, Indiana

General Objectives: a) to provide the beginning student of German with an active vocabulary of 200 words, over-learned visually and aurally, and

b) to have the student learn inductively ten of the main consonantal relationships between English and German through these 200 word examples, and

c) to help the student recognize new German words on the basis of these consonantal laws.

Courses for which Intended: Beginning German, after the first three or four contact hours of pronunciation practice of German sounds; a pre-reading program, before textbook contact hours with German.

Topics Covered: a) 200 German words related to English equivalents by 10 consonantal laws.

b) 140 Additional German words based on these laws.

Approximate Time Required: Six or seven hours for college students.

Prerequisite Knowledge: None

When and Where Field Tested: Hope College, Holland, Michigan by Dr. Gearhart, Department of German, September to October, 1964.

Results of Field Test: Material too easy for college level.

POETRY, METHOD AND MEANING: A PROGRAM IN POETIC ANALYSIS AND CRITICISM
James W. Cook, Department of English
Albion College, Albion, Michigan

General Objectives: 1. Student should use critical vocabulary when writing, thinking, or talking about poetry.

2. Student should identify figures of speech and thought when they occur in a poem.

3. Student should be able to analyze and specify the contribution of figures of speech and thought to a poem's meaning.

4. Student should be able to posit multi-level interpretations of a poem.

Courses for which Intended: Introduction to Literature or any course in which poetry, especially lyric poetry, is to be a primary concern.

Topics Covered: Basic poetic figures of speech and thought and the concepts of metaphor, symbol, and image as they interact and contribute to the meaning of a total poem.

Approximate Time Required: Four to eight hours

Prerequisite Knowledge: Freshman or sophomore college standing or advanced high school student without previous experience.

When and Where Field Tested: Ohio Wesleyan, Fall '64 Robert Ross Kalamazoo, Spring '65 Walter Waring Albion, Fall '64 J. W. Cook

Results of Field Test: Used to revise program.

ANALYTIC GEOMETRY: THE LINE
Thomas A. Davis, Department of Mathematics
DePauw University, Greencastle, Indiana

General Objectives: This program is designed to be used in a college level course on analytic geometry and calculus along with a text in analytic geometry and calculus or a text

OK

in calculus. Students taking these courses have a wide range or previous training. This program will allow each student to spend as much time on each topic as he needs, to learn the material he does not know.

Courses for which Intended: Analytic Geometry and Calculus 151 and 161 Beginning course for college freshmen

Topics Covered: The first unit of the program contains the material usually found in the first 50 or 60 pages of college textbooks on Analytic Geometry and Calculus: coordinates, inequalities, absolute values, absolute values and inequalities, directed distance, distance formula, midpoint formula, slope of a line, parallel and perpendicular lines, the angle between two lines, graphs and equations, intercepts, symmetry and asymptotes, and the straight line.

Approximate Time Required: Eight to twenty hours--mean twelve hours.

Prerequisite Knowledge: High School Algebra

When and Where Field Tested: DePauw--Fall '64, Winter '65, Fall '65
Denison--Fall '64--Sterrett
Albion--Fall '64--Moore
Earlham--Fall '64--Hanes

Results of Field Test: Used to revise program.

CONSTRUCTING THE UNIT CARD
FILING IN THE LIBRARY PUBLIC CATALOG AND SHELF LIST
CHOICE OF MAIN AND ADDED ENTRIES
CHOICE OF SUBJECT HEADINGS
CLASSIFICATION
J. McRee Elrod, Library
Ohio Wesleyan University, Delaware, Ohio

General Objectives: To Prepare library clerical and subprofessional personnel to perform a higher level of technical processing functions as listed in the titles of the programs; to allow the library school teacher to teach these clerical and subprofessional functions outside the regular classroom.

Courses for which Intended: The technical processing area of the library's inservice training program; the library schools' technical processing courses.

Approximate Time Required: Eight to sixteen hours

Prerequisite Knowledge: Typing; senior high reading level of English; general library orientation such as given college freshmen.

When and Where Field Tested: Clerical workers of the Ohio Wesleyan U. Library Catalog Department and The Defiance College Library, 1964-65.

Results of Field Test: Revisions of programs for clarity.

CAPITAL BUDGETING, METHODS OF RANKING PROJECT PROPOSED FOR INVESTMENT

Vant W. Kebker, Department of Economics
Ohio Wesleyan University, Delaware, Ohio

General Objectives: To help students understand why the method of discounting expected cash flows of income is better than other methods evaluating and ranking proposals that involve investment of capital.

Courses for which Intended: Financial Management, Business Finance, Corporation Finance

Topics Covered: Concept of discounting payments to be received in the future, methods of measuring money available to recover invested capital, methods of measuring results obtained.

Approximate Time Required: Eight hours

Prerequisite Knowledge: Accounting

When and Where Field Tested: DePauw University, Fall '64--Selander Ohio Wesleyan University, Fall '64--Kebker, Fall '65, Winter '66

Results of Field Test: Revised Program

LIBRARY OF CONGRESS CARD ORDER ROUTINE
Peter Kidder, Library
Kenyon College, Cambier, Ohio

General Objectives: The program is designed to prepare people to do preliminary bibliographic searching in connection with ordering LC cards; order them; check them in, and do necessary follow-up work.

Courses for which Intended: For use in training clerical personnel in the acquisitions and cataloging departments of a library.

Topics Covered: General introduction to LC cards, types and sources of numbers, main entries, sending orders, checking in, follow-ups.

Approximate Time Required: Six to eight hours

Prerequisite Knowledge: Basic familiarity with a library and with some library terms (Farber and Elrod's programs)

When and Where Field Tested: By 3 library employees at Kenyon and 2 at Ohio Wesleyan

Results of Field Test: Corrected errors.

HUMAN NATURE
Clarence Leuba, Department of Psychology
Wright State Campus

General Objectives: To enable the student to answer certain specific questions regarding what human nature is and is not, and regarding the characteristics making up human nature.

Course for which Intended: Introductory or Educational Psychology, Social Psychology

Topics Covered: Meaning of Human Nature, Innate aspects or raw materials of human nature, Acquired aspects of human nature, Human nature as a descriptive and not an explanatory concept, Human nature as changing, Original human nature, The concept of the "natural man".

Approximate Time Required: Eight to ten hours

Prerequisite Knowledge: College level ability

When and Where Field Tested: Earlham, Intro. Psych. classes
DePauw, Intro, Psych. classes
Antioch, Intro. Psych. classes

Results of Field Tests: Revised program to present status

THE SOIL: A PROGRAMMED TEXT
W. M. Lotkowski, Department of Earth Sciences
Antioch College, Yellow Springs, Ohio

General Objectives: To enable student to answer such questions as: what is soil and how is it formed? how do temperature, humidity, composition of the underlying rock material, vegetation, topography, time, and land use affect soil? of what use are particular soils, and how can they be used most effectively?

Courses for which Intended: Geography, conservation

Topics Covered: Physical states of soil components; texture, structure and water retention capacity; mineral composition and humus content; soil forming processes; eluviation, illuviation, and leaching.

Approximate Time Required:

Prerequisite Knowledge: For students brighter than average, generally able to grasp concepts and retain information easily.

When and Where Field Tested: Antioch College '65 Office of Program Development and Research in Education

Results of Field Test: Revised Program

FORMAL STRUCTURE OF THE SHORT STORY
Kenneth B. Marshall, Department of English
Denison University, Granville, Ohio

General Objectives: To train students to perceive function, within a short piece of fiction, of certain formal elements of structure: plot, character, narrative technique and attitude (including irony and use of symbol.)

Courses for which Intended: Introductory course in study of literature, including techniques of fiction or of literary forms required. Ability to read carefully. Best for use with college freshmen.

When and Where Field Tested:

Results of Field Test:

PERSONNEL SELECTION: A SELF-INSTRUCTIONAL PROGRAM
F. S. McKenna, Department of Psychology
DePauw University, Greencastle, Indiana

General Objectives: To provide a self instructional and self contained unit on the fundamental concepts and techniques of personnel selection. Upon completion of this program, the student would be expected to be able to read the professional literature in this field with understanding, and to develop systematic personnel selection procedures.

Courses for which Intended: Psychology of Business and Industry, Industrial Psychology, Personnel Psychology, Personnel Administration.

Topics Covered: Performance criteria, predictors, validation of selection procedures, and development of selection procedures.

Approximate Time Required: Four to five hours.

Prerequisite Knowledge: Designed for college underclass students. Previous course in psychology helpful but not necessary.

When and Where Field Tested: Wabash College, '64
Ohio Wesleyan, '64
DePauw University, '64
Revision at DePauw, '65

Results of Field Test: Used for item analysis and overall evaluation

THE LITERARY RELATIONSHIPS AMONG MATTHEW, MARK, AND LUKE
R. M. Montgomery, Department of Religion
Ohio Wesleyan University, Delaware, Ohio

General Objectives: Having completed the unit and given material selected from Matthew, Mark, and Luke, the student should be able to identify the evidence supporting the theory that (a) Matthew and Luke used Mark, and (b) Matthew and Luke did not depend upon each other but upon an unknown source in their material which does not come from Mark.

Courses for which Intended: Bible, New Testament, Studies in Gospels

Topics Covered: The two source theory about the literary relationships among Matthew, Mark, and Luke.

Approximate Time Required: Two to six hours

Prerequisite Knowledge: No previous knowledge of gospels required; designed for students with verbal skill rated at above 450 on the ACE.

When and Where Field Tested: Denison University, '65--Scott
Ohio Wesleyan University, '65--Vulgamore, Illinois Wesleyan, '65

Results of Field Test: Results sent to the center.

AN INTRODUCTION TO SYSTEMATIC ANALYSIS OF POLITICAL SCIENCE
Lois M. Pelekoudas, Department of Political Science
Antioch College, Yellow Springs, Ohio

General Objectives: To identify and to state a problem in political science, identify hypotheses and assumptions, to frame hypotheses, and to identify major approaches in works of political science.

Courses for which Intended: Introduction to Political Science

Topics Covered: See General Objectives

Approximate Time Required: About 9 hours

Prerequisite Knowledge: College level freshmen, cursory knowledge of the vocabulary of American government.

When and Where Field Tested:

THE LANGUAGE OF LOGIC

Morton Schagrin, Department of Physical Science
Denison University, Granville, Ohio

General Objectives: To prepare students with no background in modern logic with sufficient familiarity to read with comprehension recent studies in the philosophy of science and semantics which are written in this notation.

Courses for which Intended: Philosophy of Science, Semantics, Epistemology,...and could help some students in symbolic logic.

Topics Covered: Interpreting and Symbolizing in the sentencial and first order predicate calculus with identity. Class abstraction.

Approximate Time Required: 6 1/2-7 hours

Prerequisite Knowledge: College Freshmen with no previous knowledge.

underline)

When and Where Field Tested: Wabash College Fall '64 Hackstaff
Denison University Fall '64 Schagrin

HEARING MUSIC WITH UNDERSTANDING

Paul Schwartz, Department of Music
Kenyon College, Gambier, Ohio

General Objectives: An introduction to elements of music through sight and sound; a text, consisting of 9 chapters, with tapes accompanying each chapter.

Courses for which Intended: Introductory music courses, fine arts survey courses, usually offered without a prerequisite in music. Also as a review of musical elements preparing for a more advanced course in music theory.

Topics Covered: Time and pitch; meter and rhythm; intervals, scales and chords; basic homophonic and polyphonic form elements.

Approximate Time Required: One month (at 2 Chapters per week)

Prerequsite Knowledge: None, a program for beginners; no previous knowledge required.

When and Where Field Tested: - Jeanette Sexton, Music Education, School of Music, Ohio State University - Charles R. Hoffer, Director of Music, Board of Education, Clayton, Missouri - Paul Schwartz, Chairman, Department of Music, Kenyon College.

Results of Field Test: Suitable for three grade levels:
1) High school juniors and seniors
2) Undergraduates
3) Graduate students without previous musical experience.

MUSIC: BEGINNING EAR-TRAINING
L. R. Smith, H. B. Ray, R. A. Hammar, Department of Music, Kalamazoo College, Kalamazoo, Michigan

General Objectives: To develop basic listening skills (Perception of intervals and rhythmic Patterns.)

Courses for which Intended: Beginning Theory

Topics Covered: Intervals in the major scale; rhythm patterns in simple meters; intervals in minor; rhythms in compound

Approximate Time Required: One week to six weeks

Prerequisite Knowledge: Understanding of music notation

When and Where Field Tested: Albion College, Winter, 1965

Results of Field Test: Generally favorable.

BIOCHEMISTRY FOR BIOLOGISTS
William K. Stephenson, Department of Biology, Earlham College, Richmond, Indiana

General Objectives: Students will attain the chemistry and biochemistry requisite for the first course in contemporary college biology.

Courses for which Intended: General biology courses, also applicable to genetics and physiology.

Topics Covered:

Unit 1. Atoms and molecules
2. Chemical groups
3. Ions, salts, crystals
4. Bonds
5. Equilibrium
6. Carbohydrates I
7. Carbohydrates II

Unit 8. Amino Acids
9. Proteins I
10. Proteins II
11. Fats, Phospholipids, Sterols
12. Muclear Acids
13. Energy
14. Biochemical correlations

Supplementary Units
Unit S-1 Molecular Weight
S-2 p H

Three Review Units

Approximate Time Required: Average 12 hours, range 6-22 hours.

Prerequisite Knowledge:
1) No previous training in chemistry required.
2) Competence in arithmetic computation and in simple algebraic manipulation
3) Average college level entrance ability to read.

When and Where Field Tested: William K. Stephenson, Earlham College, Fall, 1964.
Francis Yow, Kenyon College, Fall, 1964
Donald Smith, Ohio Wesleyan University, Fall, 1964.

Results of Field Test: Used in revising program.

STUDY HABITS

F. P. Van Eyl, Department of Psychology,
Hope College, Holland, Michigan

General Objectives: To develop study habits that lead to a more successful way of studying textbooks.

Courses for which Intended: All

Topics Covered: Study habits

Approximate Time Required:

Prerequisite Knowledge: High School, college entering student

When and Where Field Tested: Fall '64--Earlham--McDowell
Fall '64--Ohio Wesleyan--Whitted

PUBLIC SCHOOL FINANCE

J. N. Wetmore, Department of Education,
Ohio Wesleyan University, Delaware, Ohio

General Objectives: To teach undergraduate students all aspects of public school finance--local, state and federal

Courses for which Intended: Education-School Administration

Topics Covered: Public School Finance: local, state, and federal (Program not completed.)

Prerequisite Knowledge: None

When and Where Field Tested: DePauw University

THE NATURE AND USES OF COLOR

Forbes Whiteside, Department of Art,
Oberlin College, Oberlin, Ohio

General Objectives: To help the student gain familiarity with the interactions between hue, value and intensity

Courses for which Intended: Introduction to Art Studio Courses

Topics Covered: Hue, Value, Intensity of relationships

Prerequisite Knowledge: None

When and Where Field Tested: Studio students at Oberlin College

BIRD SONGS

James B. Cope, Department of Biology,
Earlham College, Richmond, Indiana

General Objectives: To teach students bird songs with the use of audio and visual aids.

Courses for which Intended: Vertebrate Zoology II

Topics Covered: Ornithology

Approximate Time Required:

Prerequisite Knowledge: None

Where and When Field Tested: Earlham Students
Albion College
Hope College

Results of Field Test: No report

ORGANIZATION OF THE LIBRARY
Evan Farber, Library
Earlham College, Richmond, Indiana

General Objectives: To train subprofessional help in library organization and entries.

Topics Covered:
1) Organization of library
2) Unit card preparation
3) Ordering of LC Cards
4) Continuous adding
5) Films

Prerequisite Knowledge: High school education.

A PROGRAM IN COMPOSITION
Fred L. Bergmann, Department of English
DePauw University, Greencastle, Indiana

General Objectives: To enable the student to recognize and to write effective paragraphs through recognition of the basic principles of unity, coherence, and emphasis.

Courses for which Intended: College freshman English; advanced sections of fourth-year high school English; self-instruction.

Topics Covered: Unity, coherence, emphasis

Approximate Time Required: About 3 weeks in the classroom; about 10 hours individually.

Prerequisite Knowledge: Upperlevel high school seniors, college freshmen.

When and Where Field Tested: First semester '65-'66 DePauw--Pence
Ohio Wesleyan--Whitted
Kalamazoo--Roerecke

Results and Where Field Tested: Each field tester reported improvement in student writing.

FACT AND FORM: ELEMENTARY PRINCIPLES OF SENTENCE DESIGN

Owen Duston, Department of English,
Wabash College, Crawfordsville, Indiana

General Objectives: To enable the student to use the resources of sentence structure to organize the facts of his experience.

Courses for which Intended: The introductory phase of composition courses.

Topics Covered: The use of and; of subordination with when and while; of the descriptive clause with who, which, and that; of the participial phrase; of the noun clause with that.

Und

Approximate Time Required: Three or four hours.

Prerequisite Knowledge: It may take some time to determine at what level the program will be most appropriate.

When and Where Field Tested: Not yet field tested.

A PROGRAMED INTRODUCTION TO SARTRE'S ANALYSIS OF FREEDOM

Robert Fichter, Department of Religion
Ohio Wesleyan University, Delaware, Ohio

General Objectives: (a) Find the rule which governs talk about Freedom
(b) Apply the rule to talk about Freedom.

Courses for which Intended: Philosophy, religion, humanities, social studies

Topics Covered: Freedom

Approximate Time Required:

Prerequisite Knowledge: General knowledge at college level

Where and When Field Tested: Program has not reached this stage.

PASO A PASO, A BASIC COURSE IN SPANISH THROUGH MEANING AND STRUCTURE

Renato J. Gonzales, Department of Spanish,
Albion College, Albion, Michigan

General Objectives: To teach introductory Spanish; more specifically to train the student in the basic elements of Spanish by directly interacting with the languages without recourse to traditional grammar or translation skills.

Topics Covered: The pedagogical elements of the course consist primarily of 1) habit forming methods
- --repetition
- --substitution
- --question and answers

2) structure

All structure is taught not by means of traditional grammar terms but by utilizing "structural linguistics" to analyze and synthesize.

Prerequisite Knowledge: Entering college freshmen.

College

ALTERNATIVE LOGICS

L. H. Hackstaff, Department of Philosophy
Wabash College, Crawfordsville, Indiana

General Objectives: To teach undergraduate students sevel alternative systems of propositional logic.

Courses for which Intended: Elementary and/or Intermediate Logic.

Topics Covered: See General Objectives

Approximate Time Required: 1 1/2-2 weeks

Prerequisite Knowledge: Student must have studied sections 6-10 of F. B. Fitch's Symbolic Logic

When and Where Field Tested: L. H. Hackstaff, Wabash Fall '65
L. H. Hackstaff, San Francisco State '66

LABORATORY SUPPLEMENT FOR CHEMISTRY 11 and 12

Alfred Henderson and Laurence Strong, Department of Chemistry
Earlham College, Richmond, Indiana

General Objectives: To introduce students to an experimental study of interaction among the compounds of a mixture. The student sees how continuous variation experiments can provide quantitative data suitable for establishing chemical equations. He also learns to test the humidity of proposed chemical equation by designing his own continuous variation experiment.

Description of the Program: This programed study included the preparation and use of quantitative solutions in terms of mass, volume and moles. It includes colored photographic slides keyed to teaching frames of the program. The study moves from a general view of interaction to the particular situations that are defined as chemical reactions. Chemical reactions are thus defined in straight-forward operational terms. The operational approach proceeds directly to the stoichiometry it is then possible to develop a chemical equation as an interpretation of the reaction. Graphical interpretation of the data is emphasized.

Prerequisite Knowledge: For use in individual instruction in conjunction with regular lecture and laboratory instruction for first year college chemistry.

MUSICAL RHYTHM (METER, PARTS A, B, AND C)
Leonard Holvik, Department of Music,
Earlham College, Richmond, Indiana

General Objectives: To bring students to a common level for discussion of rhythm and related matters in the classroom--to give them command of the verbal material and concepts and of the actual musical phenomena concerned.

Courses for which Intended: Introductory courses for general students commonly called Intro. to Music or Music Appreciation

Topics Covered: The metrical basis of common practice rhythm, the notation of rhythm, and the subject of time signatures and related matters.

Approximate Time Required: Three to Four hours

Prerequisite Knowledge: None except that for college admission

When and Where Field Tested: Kenyon, Paul Schwartz
Albion, Doran, Obetz, Riseling
Earlham, Holvik

THE ECOLOGY OF PUBLIC ADMINISTRATION
William L. Morrow, Department of Political Science
DePauw University, Greencastle, Indiana

After completing the program, it is hoped that the student:

A. will be able to appropriately recognize and compare the major controversies and concepts surrounding the study of administration.
B. will be able to demonstrate satisfactorily the "multi-discipline" character of administration, and:
C. will possess an appreciation of the nuances and finer points of meaning and interpretation of all the different phenomena presented.

Satisfactory performance will be measured through an essay examination.

General Objectives: To help the beginning student of public administration attain a realistic perspective of the nature of administration in general.

Courses for which Intended: The introductory course in Public administration

Topics Covered: The problem of conceptualization; the ecology of administration; administration as an interdisciplinary study; administrative theory, administration as Science; administration and politics.

Approximate Time Required: 3-4 hours

Prerequisite Knowledge: Aimed at college juniors. Performance would probably be better from those who have had introductory courses in sociology, psychology, and government.

When and Where Field Tested: Thus far only field tested in own classes.

Results of Field Test: Results have been fairly successful. Revision still necessary.

INTRODUCTION TO MODERN PHYSICS
B. R. Russell, Department of Physics
College of Wooster, Wooster, Ohio

General Objectives: To present certain key topics in modern physics in a form suitable for use as supplementary material in a beginning college physics course

Courses for which Intended: Elementary College Physics

Topics Covered: Rutherford Scattering, Bohr Theory of the Atom, Quantum Concepts

Approximate Time Required: 6 hours

Prerequisite Knowledge: Mechanics, Electricity, and Optics (Calculus not required.) Average students

When and Where Field Tested: Kenyon, April '66--Miller
Albion, April '66--Glathart
Wooster, April '66--Stephenson

A PROGRAMMED REFERENCE GRAMMAR FOR ELEMENTARY SPOKEN AND WRITTEN FRENCH

Richard R. Strawn, Department of Romance Languages
Wabash College, Crawfordsville, Indiana

General Objectives: To state the grammar rules for each topic treated and to apply the rules correctly, on paper, to new instances.

Courses for which Intended: First and second semester French

Topics Covered: Gender, designation, de-relationships, adjective agreement, tense (Periphrastic future, present, passe compose,) interrogation (yes-no, questions, defining and distinguishing, written plurals of nouns and adjectives.

Approximate Time Required: 10 hours

Prerequisite Knowledge: Ability to discriminate one phonetic symbol from another.

When and Where Field Tested: Wabash College, January, Feb. '66
Celler, Strawn

CRYSTALS: AN INTRODUCTION--A PROGRAMED LABORATORY AND INDEPENDENT STUDY UNIT

John F. White, Department of Earth Sciences
Antioch College, Yellow Springs, Ohio

General Objectives: 1) to provide a stimulating and efficient programed study unit on crystals for

OK

introductory courses
2) to present the material so it can be useful for both science and non-science students
3) to provide for the integration of material that is ordinarily presented separately through lectures, text, and laboratory.

Courses for which Intended: As auxiliary material for: Intro Geology, Earth Sciences, Chemistry, Materials Science, Physical Science, crystallography, Mineralogy, Metallurgy.

Topics Covered: Crystals and Solids, History of Crystal Study, Lattice and Structure, Unit Cell Content, Relative Size of Atoms, Theoretical Density, Isomorphism and Polymorphism, Solid Solution and Imperfect Crystals, Symmetry, Review and Additional Structural Models.

Approximate Time Required: 5 hours

Prerequisite Knowledge: Ability level--first year college

When and Where Field Tested: Antioch College, Fall '65--White

Results of Field Test: Some revision and supporting frames required. Average score 89%

ELECTROPHYSIOLOGY OF NERVOUS TISSUE
Francis W. Yow, Department of Biology
Kenyon College, Gambier, Ohio

underline

General Objectives: Use and theory of Stimulator-Oscilloscope Complex and interpretation of Oscilloscope Image with respect to transmition of nerve impulse.

Description of the Program:
1) 8mm film loop showing nerve preparation and instrument complex, along with oscilloscope trace,
2) A brief program introducing the student to oscilloscope and interpretation of trace,
3) tape to be fed into oscilloscope which will reproduce nerve response as well as audio description of events.

a

Sample Pages from Selected Programs

Below are sample pages from nine programs produced in both 1964 and 1965. The first five samples are taken from programs that were used in the intensive evaluation made under a variety of conditions reported in Chapter 6. The remaining four were selected so as to illustrate the variety of programs that were produced on the project.

draw line

1. Sample page from POETRY, METHOD AND MEANING, by James Cook

36

Images constitute another very important class of figures of speech. One might say that an image results when a passage is so vividly descriptive that the reader imagines a sensory experience. For example: "The smooth and creamy vanilla ice cream, cool upon my tongue, melted gently toward my tonsils." Now, while you really can't taste the ice cream nor feel its texture or its temperature, you can imagine that taste and that feeling.

Try it! Got it? Yum!

Thus, an image is a figure of speech that represents a concrete experience or an object by appealing to the senses through the

51. ______________________________.

imagination

A poet may appeal to sight, hearing, smell, taste, touch, the senses which distinguish changes in temperature, which register balance and motion, and which register visceral reactions. For our purposes, include the last three under touch.

1. (Cont) Sample page from POETRY, METHOD AND MEANING, by James Cook

52. Which of the following quotations contain images? Circle the appropriate letters.

A. All in a hot and copper sky
The bloody sun at noon
Right up above the mast did stand
No bigger than the moon.

B. Grow old along with me.
The best is yet to be.

C. I cannot see what flowers are at my feet,
Nor what soft incense hangs upon the boughs,
But, in embalmed darkness, guess each sweet
Wherewith the seasonable month endows
The grass, the thicket, and the fruit tree wild;
White hawthorn, and the pastoral eglantine,
Fast fading violets cover'd up in leaves
And mid-May's eldest child,
The coming musk-rose, full of dewy wine,
The murmurous haunt of flies on summer eves.

Observe that the tied images in A and C are such that they evoke virtually the same imaginative responses in most readers. Look back at A and C and analyze your responses. To which senses do the tied images in A and C appeal? (They may appeal to more than one.) List them. Which words seem to control that appeal?

53. Senses Words

1. (Cont.) Sample page from POETRY, METHOD AND MEANING, by James Cook

Your list will probably be something like this one. You may have others, but if you missed these, look back.

	Senses		Words
A.	touch sight	simultaneously stimulated	hot and copper bloody sun at noon above mast no bigger than moon
B.	smell		flowers at feet
	smell and touch		embalmed darkness
	smell		grass, thicket, fruit trees, white hawthorn, eglantine, violets, musk-rose
	taste		dewy wine
	hearing		murmurous flies

2. Sample Page from LANGUAGE OF LOGIC, by Morton Schagrin 4

English sentences can be separated into those that are simple (or atomic), and those that are compound (or molecular).

SIMPLE SENTENCES

a) Small grey doves do coo at lonesome lovers.

b) The corn is quite tall.

COMPOUND SENTENCES

a) Dogs lope while horses gallop.

b) If the balance of terror persists, then the rate of cigarette smoking increases.

Roughly speaking, compound sentences are composed of two or more shorter simple sentences. Circle the compound sentences in this list.

1) The quick brown fox jumped over the lazy dogs.

2) Roses are red and violets are blue.

3) Now is the time for all good men to come to the aid of the party.

4) Fat burns, but water doesn't (burn).

5) He who never speaks never errs.

6) If a man never errs, then the Devil isn't happy.

7) Simple sentences standing alone are easy to detect, nevertheless it is often difficult to analyze a compound sentence into its component simple parts.

8) Seldom have so many owed so much to so few.

- - - - - - - - -ANSWERS - - - - - - - - -ANSWERS - - - - - - - - - - - -

2) Roses are red and violets are blue.
4) Fat burns, but water doesn't.
6) If a man never errs, then the Devil isn't happy.
7) Simple sentences standing alone are easy to detect, nevertheless, it is often difficult to analyze a compound sentence into its component simple parts.

If you are correct on all of these, turn to page 7.

If you have missed any of these, turn to page 6.

tained within them.

OK

2. (Cont.) Sample page from LANGUAGE OF LOGIC, by Morton Schagrin

You missed one or more compound sentences.

Perhaps you should concentrate on identifying simple sentences. Simple sentences have not shorter sentences contained within them.

Example: DOGS BARK.

Now modifiers are irrelevant to the logical simplicity of a sentence.

Example: Small, shorthaired black dogs often bark fiercely..

This is still a simple sentence; Some thing (the subject) does something (the predicate).

Were we to compound Dogs bark with another simple sentence, we might obtain something like:

If dogs bark, then cats purr.

Circle the compound sentences below:

1) That doctor is a fraud or this druggist is a charlatan.

2) That child kicked this child in the stomach.

3) Aversive reinforcement is rewarding to a masochist.

4) I will not run if I am nominated, and I shall not serve if I am elected.

- - - - - - - - - ANSWERS - - - - - - - - -ANSWERS - - - - - - - - - - -

1) That doctor is a fraud or this druggist is a charlatan.

4) I will not run if I am nominated, and I shall not serve if I am elected.

If you are incorrect, go to page 13.

If you are correct, go to page 7.

3. Sample page from BIOCHEMISTRY FOR BIOLOGISTS, by William Stephenson

(29)

* *

6. What is the general characteristic of the ions in the preceding item (when compared to the atoms)?

- -

The ions have gained or lost electrons and bear a charge. (or similar response)

* *

7. The sodium ion is written Na+. Ca ion = Ca++

Write the symbol for the Mg ion.

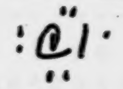
Write the symbol for the K ion.

- -

Mg++ and K+

* *

8. Outer Shell
Diagram



How many electrons can Cl accept to form an ion (complete the outer electron shell)?

Write the symbol for the Cl ion.

copy
stock
85

- -

One
Cl-

* *

9. Write the symbol for each of the following ions:

Na________ Ca________ F________
Cl________ K________
Mg________

- -

Na Na+ Ca Ca++ F F-

Cl Cl- K K+

Mg Mg++

* *

3. (Cont.) Sample page from BIOCHEMISTRY FOR BIOLOGISTS, by William Stephenson

(30)

10. Cation = + ion pronounced - CAT' ION
Anion = - ion

Pronounce cation and anion out loud 3 times each.

Label each as a cation or anion.

Na________ Ca________ F________
Cl________ K ________
Mg________

Na cation Ca cation F anion
Cl anion K cation
Mg cation

* * *

11. In the two dimensional diagram (Panel B), how many cl- are adjacent to (bonded to) each Na+?

---

four

* * *

9. With the two dimensional diagram of Panel B, construct a mental picture of the third dimension in a crystal. Remember that Na+ and Cl- alternate in each dimension. Now, in the crystal, how many Cl- are adjacent to each Na+? How many Na+ are adjacent to each Cl-?

6
6

* * *

12. A salt is a general term for an ionic compound. Of what units is a salt composed?

---

ions

* * *

13. Most salts have metallic (Eg. Sodium, Potassium, Magnesium, Iron, Calcium, etc.) cations.

Circle the metallic ion in each of these salts.

$\overset{+}{Na}\overset{-}{Cl}$

$\overset{++}{Ca}\overset{-}{F}$

$\overset{++}{Fe}\overset{2-}{Cl_2}$

$\boxed{Na}^{+}Cl^{-}$ $\boxed{Ca}^{++}F_{2}^{-}$ $\boxed{Fe}^{++}Cl_{2}$

4. Sample page from LITERARY RELATIONSHIPS AMONG MATTHEW, MARK AND LUKE by Robert Montgomery

FRAME # 2

The passages from the last frame are given you again with the words underlined where the three Gospels agree, in order that you can answer another question about the degree to which the Gospels correspond.

...he asked his disciples, "Who do men say that the Son of Man is?" And they said, "Some say John the Baptist, others say Elijah and others Jeremiah or one of the prophets." ..."But who do you say that I am?" Simon Peter replied, "You are the Christ, the Son of the Living God."	...he asked his disciples, "Who do men say that I am?" And they told him, "John the Baptist; and others say, Elijah, and others one of the prophets." ..."But who do you say that I am?" Peter answered him, "You are the Christ."	...he asked them, "Who do the people say that I am?" And they answered, "John the Baptist; but others say, Elijah; and others that one of the old prophets has risen." ..."But who do you say that I am?" Peter answered "The Christ of God."

1. Check statements which correctly describe other agreements to be found in the passages above.

   a. ____ A sentence begins with "and."

   b. ____ Exclamations occur in the same line as is shown by an exclamation mark.

   c. ____ Questions, rather than declarative sentences, occur at the same point.

2. Considering both the sharing of significant terms and trivial stylistic matters such as the use of "and," the three Gospels (do) (do not) display a significant amount of literary correspondence.

ANSWER

1. a. and c. 2. do

Is the agreement displayed above substantially more than one would expect among three who tell about the same event?

4. (Cont.) Sample page from LITERARY RELATIONSHIPS AMONG MATTHEW, MARK AND LUKE, by Robert Montgomery

FRAME # 3

1. For example, since the death of Jesus on the cross is a sacred event to Christianity, as a matter of course one (would not) (would) expect each early Christian account of Jesus' life to give a majority of his last words on the cross.

To see what the situation is with respect to the last words of Jesus, inspect the passages below which give the last words of Jesus.

Matthew	Mark	Luke	John
		"Father, forgive them; for they know not what they do."	
			"Woman, behold your son!" "Behold your mother!"
			"I thirst."
		"Truly, I say to you, today you will be with me in Paradise."	
"Eli, Eli lama sabachthani?" that is, "My God, my God, why hast thou forsaken me?"	"Eloi, Eloi, lama sabachthani?" which means, "My God, my God, why hast thou forsaken me?"		
		"Father, into thy hands I commit my spirit."	
			"It is finished."

2. (Matthew)(Luke) and (Mark)(John) agree on (1)(2)(3) of the utterances of Jesus on the cross.

3. If with regard to the very last expressions of Jesus, the situation is as it stands above we (would not)(would) expect that there would be much agreement among Matthew, Mark, and Luke about the other sayings of Jesus.

Is it an exception, therefore, to find the amount of agreement among Matthew, Mark, and Luke which we discovered in the first frame?

5. Sample page from AN INTRODUCTION TO SYSTEMATIC ANALYSIS OF POLITICAL SCIENCE, by Lois Pelekoudas

Place an x in the appropriate blank to indicate whether a problem for inquiry is explicitly posed in each of the following paragraphs.

If a problem is explicitly stated, rephrase it in the space provided or underline it in the text of the paragraph.

underline

If no problem is explicitly stated, rewrite the paragraph so that it does pose a problem for political inquiry.

1. There is no provision in the U. S. Constitution for a cabinet. Federal agencies have been formed as part of the executive branch, rather than the legislative branch of the government. Since the turn of the century, the number of federal regulatory agencies has mushroomed. A problem for inquiry is the combination of factors which have led to the formation of a federal regulatory agency and the type of structure the agency takes.

e

Problem__________ No Problem__________

To them

2. With few exceptions, all presidents who have sought second terms have been elected. One president served four consecutive terms, but such long tenure was banned by the Constitutional amendment (Amendment 22) added during the Truman term. The following study will examine the economic and political trends in the nation during those campaigns when an incumbent president failed in his bid for re-elections.

Problem__________ No Problem__________

5. (Cont.) Sample page from AN INTRODUCTION TO SYSTEMATIC ANALYSIS OF POLITICAL SCIENCE, by Lois Pelekoudas

Fill in the blanks in the review paragraph below.

Inquiry about a problem is guided by one or more _______________, which must be relevant to the problem posed. The _______________ are derived from a set of ____________________, which can be "chained back" to the most basic beliefs about the nature of knowledge, man, and the universe, and which have been formed on the basis of experienced and observed phenomena. A set of related _________________ which immediately underlie and generate hypotheses constitutes a ______________________. It functions to _____________________ and _______________________ events, and if it does so, it may be said to have utility, or to generate testable hypotheses.

......

hypotheses, hypotheses, assumptions, assumptions, theory, explain, predict

VI

6. Sample page from HEARING MUSIC WITH UNDERSTANDING, by Paul Schwartz

more

CHAPTER VI deals more fully WITH SCALES AND CHORDS.

IV

underline

You discovered in CHAPTER IV that SCALES are formed by step-wise motion, and in CHAPTER V that CHORDS are formed by wider INTERVALS than steps. In this chapter, you are invited to find out more specifically ly how a MAJOR SCALE is formed, what it looks like on paper, and how it sounds when played.

You will be introduced to several SCALES which use the black keys of the keyboard. For this reason, it is essential that you remember clearly the functions of the ACCIDENTALS: the SHARP, the FLAT and the NATURAL. By the same token, you should practice the new SCALE formations on a keyboard instrument soon after you have worked your way through this chapter.

VI-A

PRECEDING PAGE BLANK-NOT FILMED

7. Sample page from A PROGRAM IN COMPOSITION, by Fred Bergmann

II. Find the topic sentence in the following paragraph. Underline it.

The common cold is really a highly popular complaint throughout the temperate regions of the world, where it is endemic. It has all the attractions of an illness and none of the disadvantages, for it never kills anyone and always gets better within a fortnight. Meanwhile it acts as a magnet for sympathy in midwinter, when sympathy is needed the most. It grants a week's leave from the office at a time when the holidays are miserably balanced between recollection and anticipation. And as it makes no difference to the prognosis whether treatment is given or not, each cold offers its victims a delightful exercise in self-doctoring.

WO

1. The topic sentence appears where in the paragraph?__________
2. Is the paragraph unified?__________
3. Is extraneous material brought in?__________
4. Each of the sentences which follow the topic (gives a reason) (does not give a reason) for the popularity of the common cold. (Underline one.)

   Are the sentences which follow the topic in an acceptable order?__________

7. (Cont.) Sample page from A PROGRAM IN COMPOSITION, by Fred Bergmann 11.

1. The topic sentence is the first sentence.

2. Yes, the paragraph is unified.

3. No, there is no extraneous material.

4. Each following sentence gives a reason for the popularity of the cold.

5. Yes, the following sentences are in acceptable order.

The paragraph on the common cold has complete unity and perfect clarity. The topic sentence at the beginning makes a statement which calls for reasons. Each sentence which follows clarifies the topic statement by giving one reason--each supplies part of the answer to the reader's inevitable question: why? Sentence 2 indicates that the common cold has all the attractions of an illness and none of the disadvantages, as it never kills the patient. Now the reader must know what the attractions are. Sentence 3 gives sympathy as a reason; sentence 4 suggests one's right to avoid work; sentence 5 adds the opportunity of harmless self-doctoring. These four sentences have expanded upon the topic at the same time that they have clarified it.

8. Sample page from A PROGRAMMED REFERENCE GRAMMAR FOR ELEMENTARY SPOKEN AND WRITTEN FRENCH, by Richard Strawn

[z ve k m se]   [z n ve p k m se]

[z k m s]   [z n k m s p]

[z e k m se]   [z n e p k m se]

Our temporary rule in frame # 9.1 was too loose. It would let us come up with such a phrase as * [z n ve k m se p], which is wrong.

TEMPORARY RULE.

To negate a predicate, put [____] in front of the ____(or only) verb-word and [____] immediately after it.

9.2

[n( )]   first   [p]

9.3

[va marse]   [va t marse]   [n va t p marse]

[mars]   [mars t]   [n mars t p]

[n a marse]   [a t marse]   [n a t p marse]

Even our temporary rule in frame # 9.2 is too loose. It would let us come up with such phrases as * [n va p z   marse] or * [n va p t   marse], both of which are wrong.

RULE.

To negate a predicate, put [____] in front of the first (or only) verb-word. Put [____] as close after as it can come without ________.

9.3

[n( )]   [p (z)]

dividing a verb-plus-subject phrase

(or equivalent answer)

8. (Cont.) Sample page from A PROGRAMMED REFERENCE GRAMMAR FOR ELEMENTARY SPOKEN AND WRITTEN FRENCH, by Richard Strawn

12.11

INFO: Vous commencez   Je continue jusqu'a Paris
QUESTION: --Je Fais quoi?   --Que fais-tu?

The questions are questioning

(a) the predicate   (Choose one)
(b) the direct object

The construction of the question [matches / does not match] the construction of the information.

The predicate of the information [has / does not have] a direct object.

The predicate of the question [has / does not have] a direct object.

All of which makes it appear that the verb faire [f r]

... is used as a "neutral" verb of activity to question
  (c) other activities (other predicates)
  (d) only verbs with direct objects.
  (e) only verbs without direct objects.

... must itself have

  (f) a direct object, if the predicate it questions does.
  (g) a direct object, regardless of what it questions.
  (h) no object if the predicate it questions does not.

12.11

(a)
does not match

does not have

has
(c)

(g)

9. Sample page from ANALYTIC GEOMETRY: THE LINE, by Thomas Davis

	5. If we give the three x-intercepts in figure (3) coordinates A(-2,0), B(1,0), and C(3 1/2,0), what do the three pairs of coordinates have in common? ______________________________
5. the y-coordinate of each is zero	6. Thus, to find the x-intercepts of the curve whose equation is $y=x^2 - 4$, we set____________in the equation and solve for x.
6. $y = 0$	7. Find the x-intercepts of the equation $4x^2 + 9y^2 = 36$
7. The x-intercepts are the points (-3,0) and (3,0). If you had difficulty, go on to the next frame. If not skip to frame 13.	8. We saw above that in order to find the x-intercepts of an equation we ______________________________ ______________________________
8. set $y = 0$ and solve for x	9. Thus, setting $y = 0$ in $4x^2 + 9y^2 = 36$ we get __________________________
9. $4x^2 = 36$ 10. $x = \pm 3$ (since $x^2 = 9$)	10. And solving for x we get __________________

Dine

E

9. (Cont.) sample page from ANALYTIC GEOMETRY: THE LINE, by Thomas Davis

	11. Thus the x-coordinates of the x-intercept are ____ and ____. And the y-coordinates are ____.
11 — 11. 3 and -3 0	12. Thus the x-intercepts are the points whose coordinates are __________ and __________.
12 — 12. (-3,0) and 3,0)	13. In the figure below, label the y-intercepts A and B. — 11a
13 — 13. Answer figure	14. A Y-INTERCEPT of a curve is defined to be ______________________________ ________________.
14. a point where the curve intercects the y-axis.	

Relationship to Amount of Time Required to Prepare Programmed Material to Student Time Working on Program

An attempt was made to estimate the amount of time the programers worked on their programs compared with the amount time students worked on them. No hard figures are reported here; merely estimates. The reported estimates of time are given in Appendix C-1. OR

The average estimated time spent on the preparation of programed materials was 24 weeks. The average estimated time students worked on the programs was 10 hours. The ratio is roughly 100 hours of programers time to one hour of student time.

Dean's Evaluation of the Project

Deans of each college were asked to meet with faculty members who had had some contact with the Programed Instruction Project during the spring of 1966. They used these meetings to discuss the following questions and to draw up an evaluation of the project:

1. What have been the strengths and weaknesses of the Programed Instruction Project?
2. What experiences have participants had with using programed instructional materials in your classrooms? (Either GLCA-produced or commercial programed materials.) What is your evaluation of the effectiveness of these materials?
3. What has been the experience of participants with preparing programed instructional materials? What is your evaluation of the experience?
4. What do you think is the future of preparing and using programed instructional materials in this campus? That is what place has the preparation and use of programed materials in the future development of our instructional program.
5. What areas of the curriculum and instructional program have been opened for further exploration and development by the Programed Instruction Project? That is, where should we go from here?

underline

und

Seven deans reported on their meetings. A brief resume of the reports including suggestions and insights of the deans follows:

underline

Strengths and weaknesses of the project of the seven reports returned by the deans five mentioned as a major strength that the

OK

preparing of programs was a good pedagogical experience, that teaching had improved as a result and that faculty members were better equipped to organize and evaluate all methods of their own teaching.

Four of the deans mentioned that the broad nature of the program was a major strength--several kinds of programs, including production of slides and many disciplines were included. Programers were encouraged to think and work in large educational ideas rather than in restricting themselves to "conventional programed materials". These also mentioned the value to the campus as a whole of the idea of programing and use of a few completed programs.

[illegible]

Several deans mentioned the high quality of the training that programers received.

Weaknesses of the project included mention by most deans that preparing programs was extremely time-consuming, although it "was not tedious". Several suggested that partial of full released time for participants would have improved both the production and the finished programs. Four deans felt that the evaluations of commercial programs were not adequate and that the follow up was poor. Three of the reports referred some danger in the humanities "Of arriving at a sense of absurdity through a programed technique". Some areas of literature, for example, do not have an innate logic and are not "susceptible to the rigidity required."

Use and effectiveness of programed materials. There was general agreement that programed materials did achieve their goal, that students did learn the material and instructional time was saved. A few faculty persons mentioned that not all students learn well from this kind of material, although whether the specific program or the use of programs generally was at fault was not clear. The novelty effect proved valuable, and most participants felt the program was very good for part of a course. One report stated: Programs were used in music, logic, physical science, short story, economics, psychology, and mathematics.... Our results were mixed to very good. Another report reads: the usual comment concerning this was "excellent"--it was a discussion of nothing but praise for the involvement as participants. Another report stated: In most cases...teachers felt it assisted in focusing student attention upon necessity for careful definition and clear distinctions...seemed to lead to more precision in discussions and a better command of terminology at an early stage...several, however, felt that results achieved may be more superficial than penetrating and tended to show little effect in final essay examinations.

[illegible] part

Preparing programed materials. All of the deans reported that programers found preparing programs to be very time-consuming, but rewarding, with insights into the teaching-learning process as a bonus. One report said: Programed material helps to break "mental blocks" and forces students to dig into material they would ordinarily skim over...on the other hand pressure for consistent and paced

V

use of programed materials was necessary.

Future of preparing and using programed materials. There was cautious enthusiasm for the future of both use and preparation of programed materials, with "bright" and "promising" the words most used. Most deans felt that short programs would be written, more film loops would be prepared, more faculty members would see value in programed materials. One college is seeking a person to be a Director of Communication who will be an expert both in use and production of all kinds of instructional materials who will help faculty locate and use programed materials. Several deans mentioned a need for teams of writers and for subsidy to encourage programers to prepare materials. There may be a moving away from lectures to more and more self-paced learning, with consultations with a teacher at a time of crisis more possible than formerly. One dean felt that program preparation would have the effect of production of better textbooks and of improved understanding of instructors of the effectiveness of their presentations.

Tr

pos

Areas for further exploration and development. There was general agreement in the reports that more research and development in the teaching-learning process was indicated, that more programs should be produced and more faculty persons involved in at least practice of preparing programed materials, and that for any successful carrying out of such activity funds would have to be found to release faculty members for such activity.

Other Comments. During the discussions in the various colleges several pertinent points were made. One group suggested further cooperation among GLCA colleges including a resources center. Another group felt that many college teachers see themselves as professional scholars, not as educators. Several mentioned the lack of clear understanding of relationship between teaching and learning..."development of the theory of learning should be the basis for teaching evaluation and improvement."

meng

ar

Evaluation of Team vs. Individual Preparation of Programs

A second important objective of the extended contract of the Project was to compare two methods of preparing programed materials, individual and team preparation on subsequent instructional processes.

re worded

It has been extraordinarily difficult to implement the team concept in the process of preparing programed materials. The major problem is that of communication, a second, almost as important is that of scheduling.

Ideally, the proposal for preparing programed material should come out of a team or group. That rarely occured in the Project.

At the time that a proposal to prepare programed material was presented to the Director, it should have geen evaluated by two panels: 1) a panel of experts on programing who would evaluate the feasibility of programing the material, and 2) a panel of content experts who would evaluate the value of programing the material for the discipline. The Project relied only on the former panel to make the selection of programers for the summers of 1964 and 1965.

A panel of content experts was not used in selecting the programers because of physical and financial problems of getting together so many persons-one panel for each area of subject matter-and because of anticipated problems of getting satisfactory evaluations from them if they worked individually. Obtaining evaluations from one panel was difficult enough to discourage further attempts to get other panels.

enough

A second ideal point for interaction between programer and content expert would have been after the time that the programers were selected and notified of their having been chosen to prepare programed material and prior to the time of the first summer training workshop. During this period, however, the college schedule worked against the possibility of team action. April, May and June are extremely busy months in college. Although we asked the selected programers to prepare an outline of what they expected to program during the summer before they came to the first workshop, we harbored many doubts about their willingness or ability to work even that far ahead. Besides our agreement was for them to write their program during the summer. Some of them had only very sketchy ideas of what they were going to do by the time of the first workshop.

During the first training workshop, the content editors could conceivably have worked with the programers. But the latter were completely preoccupied with the process of programing. The same was true during the period between the first and second workshops. By the time of the second workshop the programers were still highly involved in the problems of programing. During the second workshop they conducted the first developmental test of their own two students. Testing the program in this manner was in some cases rather disturbing and sometimes pointed to the need for extensive reorganization and revision of the program. Content editing seemed to be rather inappropriate at this time as well. Besides, by the middle of July, it became unusually difficult to locate college personnel unless they have previously committed themselves to work on the project.

think

Finally, almost in the middle of summer, the programers began to be able to think about using content experts to review their programs. At that time the director of the project wrote to at least two persons for every programer inquiring into their availability as consultant to review the program for a given programer. In most cases the programer availed himself of the opportunity to get advice from such content experts.

However, by the middle of the summer the programs had crystallized to such an extent that the content editors were not likely to be able to introduce a change in the content of the program as they might have been had they been used earlier in the process of programing.

Study of the Broader Effects of Programing

Objective 6 of the original contract and objective 2 of the extended contract both call for a study of the broader effects of programing. After the first summer of programing, the Director sent out a questionnaire to ascertain what effects the experience had on the programers concept of teaching. After the second summer of programing a more sophisticated study was designed to assess more precisely the extent and nature of the impact. The results of these studies are reported in Part III of the report.

Summary of Project Activities

All GLCA colleges participated in the three-year Programed Instruction Project and were kept in touch with the various activities of the Project through the Director who communicated with a Liaison person on each campus. The Liaison Committee met a total of five times. The Director described the Project to the faculties of all the colleges and made numerous contacts with faculty members on the various campuses for a variety of purposes related to the project. Two major all-Association conferences were held. The first was a series of winter work conferences held early in the life of the Project to introduce the colleges to Programed Instruction, the second was a Final Reporting Conference in which the results of the Project were disseminated to all the colleges.

RESULTS

Thirty-six programs were produced in the two summers of the project. They were field tested in GLCA and other colleges. The programs are all relatively short, topical programs. Each college has received a sample of all the programs that were submitted to the Director's office. Eight programs are currently being commercially published and probably several more will be published in the future.

Five GLCA produced programs in the fields of science, social sciences, and humanities were rigorously and systematically evaluated under a variety of conditions in 8 GLCA colleges, by 26 faculty members involving approximately 1200 students. The evaluation attempted to ascertain whether programs teach as well as other conventional instructional methods, whether they are best used before or after classroom discussion of the given material, whether they are used most effectively with lecture or with question and answer discussion and the effects of motivation on students' learning by means of programs. Characteristics of students evaluations and faculty evaluations were also obtained. In addition a dozen commercial programs were evaluated.

The impact of preparing programed materials on the programers concept of teaching was investigated.

Forty-two programers were supported by the Project and were intensively trained in the principles and procedures of programing. Six editors received further intensive training to consult with the programers. An estimated 200 (about 15% of the total GLCA faculties) were directly involved in the project through conferences, preparing programs, field testing programs, evaluating them, and through contacts with the Director. All faculty members were alerted in varying degrees to new media of instruction through the initial round of faculty meetings, and two rounds of visits to display programs. The results of the project were reported out at a Final Reporting Conferences in Columbus, Ohio on April 29, 1966. Eight institutions and agencies other than GLCA colleges were involved in the Final Reporting Conference.

PRELIMINARY CONCLUSIONS

Professors in GLCA colleges can prepare high quality programs. Preparing quality programs is a very time consuming process with respect to the amount of student time in using the programs.

The deans of the colleges generally evaluated the project favorably.

GLCA faculties demonstrated the value of having an association of colleges prepare and evaluate programed materials, the feasbility of a cooperative project demanding a high level of coordination and cooperation, and the possibility of disseminating information on instructional matters. The Project focused the growing interest of the teachers on the process as well as the content of teaching, on pedagogy as well as scholarship. It can be concluded that GLCA faculties and probably faculties of other associations of colleges can successfully undertake projects demanding a high level of cooperation.

Let us review the objectives of the Project at this point to ascertain in a preliminary fashion the extent to which they were attained. The Project operated under two sets of objectives, the original ones and those that were formulated for the extension of the Project. They are given in the Introduction to this report.

In the three years of its life, the Project accomplished the following:

1. Reviewed and evaluated commercial programs (original objective 3).

2. Developed three dozen programs (original objective 4).

3. Intensively evaluated five GLCA-produced programs under a variety of teaching conditions (extended objective 1).

4. Described the broader effects of programing on instructional processes of programers (original objectives 5 and 6, extended objective 2).

5. Disseminated results of the Project as far as possible both within GLCA Colleges and in other liberal arts colleges (extended objective 4).

Detailed description of the attainment of the above objectives is given in the remaining chapters of the report and summarized in both the Introduction to the report and the final chapter.

The Project experienced the most persistent difficulty with respect to the attainment of the original objectives 1 and 2 and extended objective 3. The first two objectives dealt with the determination of areas within the curriculum common to the same departments in various colleges which lend themselves to programed self-instruction and the determination of specific behavioral objectives to be achieved in those areas of the curriculum. The third had to do with team production of programs. Special attention needs to be paid as to why the Project was less successful in attaining these objectives than the other objectives.

As will be seen in later chapters, the evaluation of GLCA-produced programs did demonstrate that programs dealing with subject matter within the three major divisions of the liberal arts curriculum all taught effectively. This result indicates tentatively at least that there is nothing inherent in any of the major areas of the curriculum that would prevent programed instruction from being developed and used effectively.

The first two original objectives go further, however, than simple successful use of the programs in various curricular areas. They suggest that content to be programed originates from within the curriculum, that instructors can agree on areas of the curriculum that lend themselves to programing, and that behavioral objectives for such areas of the curriculum can be formulated and consensus reached upon them. Underlying these two objectives are the following assumptions about GLCA Colleges and the Project: 1) That there was a sufficiently high level of cooperation attainable to make such agreement on the curriculum and objectives possible,

2) That there was a sufficiently high level of pedagogical sophistication and interest to make possible the determination of behavioral objectives and areas within the curriculum that were programable, 3) That the Project had the resources and time to bring about such agreement and consensus.

As indicated in the previous chapters, the above assumptions proved to be largely untenable. The visits of the Director to the GLCA campuses and the Winter Work Conferences were not sufficient to bring about the meetings of minds that was required by the two objectives. Even the second round of programing failed to achieve the extended objective number 3 of program production by team interaction. As a result, the Project resorted to the individual approach, encouraging individual instructors to prepare programed instructional materials primarily for their own use and secondarily for use by other interested persons.

Why was it so difficult to obtain group consensus on what needed to be programed and cooperation on production of programs? Several answers suggest themselves:

1. Teaching is a highly individualistic matter in GLCA Colleges and obtaining consensus and cooperation runs rounter to long-established individualistic pedagogical traditions.

2. Most instructors were relatively unacquainted with programed instruction; some were even antagonistic. One of the major tasks of the Project centered around not only disseminating the products of the Project, but also providing fundamental basic information. Planning rather sophisticated cooperative methods of developing and utilizing programed instruction was beyond the competency and interest of most faculty members.

3. A major question needed to be answered before wide-spread interest in programed instruction could be assumed: Are programs effective pedagogical devices at all at the college level? Until that question was answered - which was done affirmatively by the Project - many instructors could not be interested in preparing or evaluating programed instructional materials.

4. Programed instruction has less of a relationship to the content of the curriculum than it has to the methods of teaching. The curriculum as such failed to generate programed instruction. Rather the Project attracted individual teachers to prepare programs who were interested in experimenting, who were experiencing difficulty in communicating to students who were intrigued with the

possibility of improving the exposition of ideas, who were facing problems in presenting certain concepts, who were concerned with improving instruction in their own classroom. The source of motivation then to produce programed instructional materials seemed to be more personal than curricular or institutional.

The failure of the Project to attain objectives number 3 of the extension of the Project is related to the failure to completely attain objectives 1 and 2 of the original contract. Programers, editors and content editors were practically impossible to bring together in a team arrangement because of simple scheduling problems of bringing people together in the summer time of year when most of them were intent on vacationing or pursuing their own personal interests. It still remains to be seen, however, whether a group of programers working in concert might not reinforce learnings and thereby magnify the effects of programing upon instructional processes to a greater extent than programers working individualistically.

This is not to say that the first two original and the third extended objectives are unattainable. It does suggest, however, that it may be necessary to have experienced programers rather than novices in programing address themselves to the areas of curriculum to be programed and to the formulation of behavioral objectives. With their training and experience in producing programs as background they would possibly be able to do effectively what relatively inexperienced programers found difficult, if not impossible to do.

Part II Evaluation of Programed Instructional Material

Chapter 4

REVIEW OF RESEARCH IN PROGRAMED INSTRUCTION AT THE COLLEGE LEVEL

By M. Daniel Smith

There are two general categories of research in programed instruction; ~~that~~ the one stressing experimental analysis, and ~~that~~ the other stressing experimental design. The former emphasizes careful development of a sequence of learning tasks, the latter the comparison of treatments which differ in one of a few variables (or multivariate investigations with sophisticated statistical design). The former involves small numbers of subjects, the latter large numbers for obtaining statistical significance. Some recent developments point to the possibility of a compromise (14). This chapter represents a review of research of both kinds.

s

Research involving experimental analysis:

An early attempt at programing was made by Socrates, and reported by Plato in the Meno. It involved mathematics and was discussed and demonstrated before a collegiate audience, although the trial student was reportedly a slave boy. It involved rather repetitive responses and was overcued; there is some evidence that the author did not mean it as a serious example of pedagogy. Broad scale programing was also characteristic of the efforts of the Sophists and later the Jesuits; their efforts were developed with practical, specifiable end products in mind, and certainly represent an early form of behavioral analysis and sequencing of learning experiences.

student

Skipping some hundreds of years, we note next the work of Pressey, which involved immediate feed-back from tests; this was conducted with attention to experimental design as well.

✓

The earliest thoroughgoing development of a program was carried out by James Holland and B. F. Skinner; they used parts of Science And Human Behavior (by the latter) and expanded them into the well known program Analysis of Behavior. It was first presented via teaching machines of the disk type. The program went through several extensive revisions, each based on feedback from large numbers of Harvard sophomores. It was noted that increases of length due to addition of frames resulted in decreased learning time and improved results. Students reacted negatively to the confining nature of the experience, both physically and cognitively speaking, but since the students did much better on final examinations than they had before, the authors concluded (evidently) that they were justified in overlooking the kind of complaint with which less favorably endowed institutions wrestle so timorously. Some experimentation was done

OK

with various response requirements; it was shown, for instance, that the choice of response requirement in a given sentence or paragraph is important and determines how much and what the student learns. Some work was done with retention, indicating that it was not a case of "easy come easy go"; however, the absence of good comparative data from "conventional" treatments hampered efforts in this direction. Generally it became obvious at this early date that there was no good way to compare "programed instruction" with "conventional teaching", since there were so many different facets of conventional teaching and since there were so many uncontrollable variables which would be involved. Outside of this, very little was done with college students by the Harvard psychologists. The author used short programs in physics and mathematics, with some success, but also with the negative student reaction attendant on experiments involving individual learning styles. The main thrust of the research on this project turned toward younger children.

Research in teaching Russian conducted by Keith Myers at Earlham College is one logical successor to the analysis involved in Analysis of Behavior; another is the program in statistical inference by Celeste McCullough and Loche Van Atta at Oberlin; one should also mention the Genetics program by Edward Kormondy, involved in research design experimentation reported elsewhere.

The work in Russian by Myers was pioneering in that it involved the design of special dual tape-deck audio-lingual capabilities for the express purpose of carrying out the needs of the program (unfortunately most machine carry out the dreams of the designer rather than any particular tutorial requirements). This machine design also involved some forward-looking prototypes of language laboratory equipment by John Gilpin, an associate on the Earlham project. Dr. Myers conducted one experimental class in beginning Russian entirely through machine and text, with no contact with students except through tapes recorded by them and correction tapes made by him. Students questioned four years later reviewed the experience as helpful; some went on to advanced Russian after less than a term.

A program in Spanish developed by Rand Morton at the University of Michigan stressed discrimination learning in acquiring Spanish pronounciation and vocabulary.

The work in statistics by McCullough and Van Atta at Oberlin was more conventional in format and subject matter; it too received extensive trial and revision, and stands today as one of the better examples of the sequencing of learning experiences in topics traditionally looked upon as college level.

The work of William Stephenson, O. T. Benfey, Hugh Barbour, Howard Alexander, and Leonard Holvik on the Earlham project has been reported in detail in a final report of that project. Generally it was found that programed materials were well received by the students, were effective in communicating concepts which had previously caused difficulty in their respective courses, but took a great deal of time and effort and persistence to prepare. The Earlham project also noted that programs from other locales, with a few exceptions, were not as well received: either they did not cover relevant material, or the material was not college level in quality. Under the pressure of a three-term system in Earlham College, it was even more difficult to get students to experiment with this often rather slow approach to learning. It was noted that some programs did the student a disservice by requiring him to learn at a pace which was less than that to which he was equal and accustomed.

Since the production of these early programs, a great many have become available through commercial publishers, often demonstrating many of the unfortunate characteristics of early programs as well as a lack of understanding of subject matter. College professors, concerned with traditions of excellence in teaching, competence in subject matter, and concern for the student, have been prone to premature dismissal of a potentially excellent approach to learning, one which can demand more of the student and give him greater returns than is characteristic of his experiences in college today.

Research Involving Experimental Design

The earliest study of programing at the college level employing experimental design also employed analysis to the extent that it emphasized careful development of the programed materials before using them to compare programing with other approaches to teaching. E. J. Kormondy and E. L. Van Atta used a program involving the field of genetics to make comparisons between several more or less conventional teaching approaches, and furthermore did so on more than one campus. In a sense, this study, utilizing as it did samples of students from Oberlin and from Earlham, foreshadowed the present project.

The program was described as follows (9)[13]

> "The subject matter of the biology program comprised a review of mitosis and an introduction to meiosis and basic genetics. This section of the course contains basic information suitable for programing and complex and technical aspects fundamental to the mastery of a significant portion of the content of the course. The programed materials were first given during the fall semester of 1959-60 to 184 Oberlin College students enrolled in an introductory course in zoology, and in collaboration with Dr. William K. Stephenson of the Department of Biology of Earlham College, to 161 beginning biology students

---

[13] See Appendix D-1 for Bibliographic references.

> at Earlham College. A revised version..was given during the fall semester of 1960-61 to 213 Oberlin College students."

The experimenters cast the program as a programed text, and also prepared an "experimental textbook; which contained the same material as the programed textbook; for the most part being an identical word-for-word reproduction of the programed text but arranged in paragraph form and having no blanks to be filled in or problems to be solved except that at the end of each chapter." The experimental groups did not attend the three lectures presented during the experimental period: Experimental group 1 used the programed text, Group 2 used the same materials and also a booklet of 91 review items arranged into four review lessons, and Group 3 used the experimental textbook exclusively. Control Group 4 attended three lectures and were strongly encouraged to study their textbook (General Zoology by Villee Walker, and Smith) an additional six hours; control group 5 attended the three lectures, studied their textbook (different textbook at Earlham), but were not especially directed to study in any particular way or for any particular time. Control group 6 did not attend lectures but were assigned to independent study and referred to the same pages of their textbook as Group 5.

ing

In discussing their results, Kormondy and Van Atta observed:

"Oberlin, 1959: The three groups using experimental materials (groups 1, 2 and 3) performed equally well and significantly better than group 5 which followed a conventional learning procedure. In addition the three experimental groups performed better than group 4 which used a conventional textbook for independent study: in each of these cases the differences between the means approaches significance.

Earlham: The three groups using experimental materials (groups 1, 2 and 3) appear to have done no worse and no better than group 5, which followed a conventional learning procedure, and significantly better than group 6 which used a conventional textbook for independent study.

Group 3 showed less improvement than either of the other two... but...group 3 are computed from a higher pretest performance, than either of the other two groups.

Oberlin, 1960: The three groups using experimental materials performed as well and showed greater gain scores than groups 5a and 5b, both of which followed a conventional learning procedure...

Student reaction...was sampled in the 1960 Oberlin experiment... the majority was favorable disposed toward the materials and procedures used...(in each experimental group)...."

Kormondy and Van Atta concluded that students appear to learn more effectively and efficiently in independent study with material designed for independent study than with conventional textbooks; they observed that the groups using programs with and without review and the group using the experimental text (based on the program but without response requirements and with conventional paragraph format) did equally well. This was an early indication of the relative power of the various factors involved in programing, primarily the response-requirement factor and the organizing-sequencing factor. Here it seems that the organization and sequencing of the materials was more important than the requiring of responses of the students. It should be kept in mind, however, that the "experimental textbook" was the result of the programing process; it might be well to consider it an advanced type of program, which relies primarily on the clarity and organization which results from the trial-and-revision process characteristic of program development.

About the same time as the Kormondy study there was general preoccupation with the problem of programed text versus teaching machine. Goldstein and Gotkin(3) laid this to rest fairly well in a review of research, some of which used college students among its subjects. None of their studies reported significant differences in mastery of subject material between machine and programed text presentation of the same programed sequence. The texts saved time, however.

Also about that time Roe (11) compared branching methods for programed learning, using freshman in engineering at UCLA, and found that "careful sequencing of items has a signifant effect on student performance, at least for programs of some length and complexity. While there was a significant difference in learning time (but not in text scores) favoring the forward over the backward branching procedures, there was no significant difference in either learning time or test scores between the forward and the linear methods. Therefore, the simple branching procedures tested here do not, by and large, seem to be more effective than a linear procedure...." This was again one of many studies which culminated in no significant differences between the treatments studied. It also typified the adaptation of conventional research approaches to programing research, in that the materials are described as consisting of "six introductory and instruction items, 93 items covering seven concepts of elementary probability (relationship between information, degree of certainty, and probability measure; sum of probabilities...), and 14 criterion test items (two for each of the concepts). The programed material was administered first to a few individual students, revised, tried in a pilot study with 55 students in a similar freshman laboratory during the spring of 1961, revised again, tried on six individual students, and revised for the last time prior to the September 1961 experiment." The length of the program, and the large-group nature of the trials which preclude a close analysis of the effect of the type of sequence and nature of task on the individual, place in some doubt the effectiveness of the program and its appropriateness as an example of what "programing" can do.

Della-Piana (2) wrote a report regarding programing as related to motivational characteristics of the learner; using what was a reasonably well developed program on Rogerian counseling with college juniors in a course in psychology for secondary school teachers, the experimenter came to a number of conclusions of interest. In discussing an item-analysis of post-program measures, it was concluded that "the program was not as effective in getting subjects to be able to label new counselor responses and to produce specified counselor responses as it was in getting responses actually called for in the program, and that the tests pointed up the kinds of behaviors that need more effective programing. It is clear that many students are able to produce written counselor responses (of a specified type) even though they were not called on to do that in the program, but that more effective production of this behavior might follow actually calling for such responses in the program."

Another conclusion was that data regarding different response modes which were used for different groups indicated no significant differences, and confirmed in part the hypothesis that the importance of response mode is inversely related to the probability of correct responding; i.e., when the program is easy, differences in response mode are not significant. This conclusion was based originally on work with overt versus covert responding, where response mode was important only when the program was "difficult" (in some cases, the material was essentially unprogramed.) Della-Piana also involved motivation in the study, through use of the Osgood semantic differential; results were not particularly informative, although it was found that the subject's performance on the constructed response version of the program was correlated with his evaluation of the treatment, implying the better motivated subjects performed better.

Green, Weiss, and Nice explored the use of a programed text in a medical school course at Dartmouth College, using a course in Parasitology enrolling twenty-two students. The original program was tested for error rate and edited to insure accuracy after use by one class during one year, and was rewritten before the experimental use. The experiment was designed to provide two counterbalanced groups with each student serving as his own control; both groups, A and B, received a common core of instructions consisting of an introductory lecture, films as they pertained to the subject, and common laboratory periods. While Group A followed conventional procedures, Group B used a programed text, and vice versa; when using the program, each group was instructed not to attend lectures or use any other reading material other than the program. In the discussion, the experimenters observed that:

> "The demonstration of the effectiveness of programed instruction in the experiment rests primarily on the examination results... performance on the examination was significantly superior at the .01 level to that performance on the same examination for which the students had prepared in a conventional manner...Test performance resulting from non-programed study is much lower for the bottom five students than it is for the top five...The difference between programed and non-programed performance for the top five students is not statistically significant. The difference between programed and non-programed study for the bottom five students in terms of examination performance is statistically significant beyond the .05 level. ... The total study time for non-programed instruction is significantly greater than the time spent in programed instruction for both experimental groups, separately and for the entire class combined. ... The program emphasizes the points which the programer considers to be important for the student to know. The student is therefore saved the effort of reading a large mass of material and sorting for himself those essential points from less important aspects of the material..."

.01

The experimenters also made an observation concerning the "difficulty" of the program:

> "The density of the program used in this experiment was very high compared with other programs commercially available for use at the college level. Previous experience with an earlier form of this program indicates that, with students of high ability, the programed materials should be more difficult in order to sustain interest and to maximize effective learning. This is not to imply that the program should constitute an examination, but rather to indicate that the larger step size of a program for students at this level is a more effective device."

This confirms observations made previously in the Earlham College Project report, described briefly above.

A study of the use of programed instruction presented via television was conducted at Penn State by Carpenter and Greenhill(1). One objective of this study was to determine whether there were differences in learning programed material over television in comparison with the conventional face-to-face instructional class covering the same subject matter. Thirty college students were randomly placed into (1) a televised program or (2) face-to-face non-programed instructional treatment. Each class met for the same amount of time, and a pre-test showed no differences in the groups. Both groups learned: no differences in performance between the two treatment groups were found on any of the four post-tests which were used to measure learning. Students in the face-to-face group reported more positive attitudes toward their instructional procedure than did the students in the televised treatment.

On another study, involving English grammar programing, with two students using one program simultaneously and discussing difficult points,it was indicated that personality variables taken into account in pairing the students did not effect subsequent performance significantly.

Using a program entitled "The Expository Use of the English Language" on the 1962 entering freshman class at Fairleigh Dickinson (8), these experimenters found that verbal aptitude was measured by the SAT-V appeared to be positively related to gains in writing ability (as measured by the STEP-Essays) but not to gains in the ability to recognize correct English usage (as measured by the STEP-Writing Tests). They concluded that students did not learn the expository use of the English language better through out-of-class programed instruction than through conventional out-of-class assignments. They comment that:

> "the results of our study underscore the great need for extensive research into the linguistic habits of native speakers as well as the need for finding appropriate programing techniques for conveying sophisticated, complex content in an accurate and interesting way."

A two-way design of analysis of variance was used by Moore and Smith (10) to compare the effects of knowledge of results, knowledge of results plus knowledge of what the correct response should be, knowledge of results plus an extrinsic reward, no knowledge of results, and the effects of using a teaching machine as a programed text for two modes of responding (multiple choice vs. constructed response) in a programed instructional format on the achivement and attitudes of introductory psychology students. Equal numbers of Ss from each of two sections were assigned to each of the groups. Ss met with their regular classes for two one-hour periods each week for 15 weeks, and they met with their respective experimental groups for two one hour periods each week for six weeks. 1,152 frames of the Holland-Skinner program were used, adapted to multiple choice for that treatment. None of the treatments resulted in significant differences on the criterion measure, which was two achievement tests constructed for the experiment. The authors felt that the failture to obtain significant differences could be attributed to lack of sensitivity in criterion instruments, differences in learning strategies adopted by the groups to make up for treatment differences, or perhaps other variables, but that it was quite likely that the treatments themselves actually did make no difference. While it is not explicitly stated in this study, the assumption has often been apparent in other studies that knowledge of results (presentation of the correct answer) in equiva-

Vn

lent to reinforcement in the three-term contingency; it is becoming clear that this assumption is unwarranted, and the results of Moore and Smith may be considered in part further confirmation of this.

In another more recent study, Moore and Smith (14) investigated learning set formation in continued discourse via programed materials, one with a population of 315 college students. The major independent variable was the number of programed units experienced by S; the dependent variables were an achievement test score and the error-rate for each program studied. For college Ss, achievement and error rate varied as a function of the number of previous programs experienced, independent of order of presentation of the programs. The effects were positive for the first programs experienced and tended to become negative for a fourth, fifth, or sixth program. The experimenters suggested that the findings might be a function of the interaction of cognitive, motivational, and attitudinal factors. This study seems related to a problem in student reaction to programed instruction which has puzzled investigators for some time--that where the student, although reacting favorably to the programing approach, finds it more and more difficult to return to the program after breaks lasting from hours to days. This has seemed to the author of this review to be related to something akin to reactive inhibition; it is as if the student built up a negative reaction to responding to a program and as if this reaction were cumulative in nature over a learning session. In a recent study reported in Journal of Educational Psychology, Ss were grouped according to demonstrated reactive inhibition (hi vs. low) and were compared on post-test performance after learning through programed instruction; the high-reactive-inhibition group was significantly superior on this criterion. This neither confirms nor contradicts the previous observation, but it does suggest strongly that reactive inhibition is involved, that there is such an "alienation" effect, and that this factor in learning from programed instruction needs to be explored extensively.

Moore and Smith conclude further that "the learning set appeared to be formed during experience with the first three programs, regardless of the order in which the programs were presented and regardless of the subject matter of the program. Further, experience with three additional programs tended to have a slightly negative effect on achievement as represented by gain scores. They hypothesize that the college Ss initial responses to the novel situation were strongly positive, but that by the beginning of the fourth week college Ss shifted toward the "more of the same" position. This suggest to them that the learning set is largely motivational and attitudinal.

Summary

This review has not been intended as an exhaustive summary of research in programed instruction at the college level, but rather a

0 OK

review of some studies which collectively give a representative view of the state of research. It does not seem to the author that things have changed too markedly since 1960, although some of the more recent studies have brought up problems which are a bit surprising and promise fascinating results in the future. One area of research which has not been included here is that involving computer based instruction. This area has not as yet developed to the point where results differ markedly in nature or import from those reported, particularly at the college level.

In closing, it may be appropriate to observe that the research designs used in exploring programed instruction at the college level have not in general been sophisticated, nor have they involved consideration of many of the variables of current interest in educational research. There has been little to relate the reactions of students (as well as their performance) to creativity, anxiety, and other special factors. There has also been very little in the way of multi-variate investigation of the various factors involved; such studies as Siegel's "The Instructional Gestalt: A Conceptual Framework and Design for Educational Research" should be imitated in their use of multi-variate design. (12) Where programs are involved, however, additional restrictions are in order; most importantly, the programed material should represent the outcome of an intense behavior analysis involving individual students and small groups. Only in this way can the experimenter achieve an approximation to an optimal path from the initial state of the learner to the final state, and only in this way can one assert that the research, once done, has relevance to other research involving programed instruction. There are many variables within programing whose interactions are not yet understood; as early as the Kormondy study it became apparent that the organizational--sequential variable might be more powerful than the active-response or feedback variables, and that what we recognize as "programs" may be only a stage or phase in the development of the highly effective instructional sequence of tomorrow.

Finally, we should abandon the programed instruction vs. conventional instruction approach as misleading and futile; the preponderance of n.s.d.'s in such research confirm and reconfirm the view that the number of variables involved and lack of control over them makes worthwhile research impossible here. Let us accept the fact that programed instruction does teach and face the related one that in "conventional" instruction we actually teach much less than we are willing to admit, much less reveal through controlled studies. The reactions of students are not a final criterion for use or nonuse either, but testimony concerning the aversive effects of some programs cannot be swept under the rug; as one of the studies reported above concluded, and as was observed as far back as the report on the Earlham project, we have not as yet matched the sophisticated learning processes of college students with appropriate sequences of tasks. This does not mean, however, that we cannot.

Chapter 5

EVALUATION OF COMMERCIAL PROGRAMS

INTRODUCTION

One of the original objectives of the project was to review existing programs in order to identify those which could be used in various departments and to arrange for detailed evaluations and field testing of these programs.

On several occasions the Project Director provided the opportunity for faculty members of GLCA colleges to examine, use and evaluate commercial programs. The first of the opportunities was offered in January of 1964 when the Project Director sent out a list of materials that were available in his office to the liaison persons to be distributed to department chairmen. The second opportunity occurred during the Winter Work Conferences in 1964 when commercial programs were displayed at the conferences. The third opportunity occurred in May of 1964 when the Director visited each of the colleges and displayed the programs for a whole day on each of the campuses.

The faculty's response to the commercial programed material could be best characterized by the term indifference with occasional displays of interest. Although a fairly large number of faculty members were exposed to commercial programs, only a few of them showed interest in using the programs and still fewer in systematically evaluating them.

The indifference was not wholly unexpected. By no means were all the 150 commercial programs that the project accumulated of college level quality nor in areas that would appeal to faculty members in GLCA. Some of the faculty members indicated that the only way they could use the programs that were available in their field would be as remedial programs. In addition, the greatest proportion of the programs was in the field of mathematics. The sciences were the next best represented. The modern foreign languages were the third. The rest of the disciplines were represented by only a smattering of programs. In a small number of the disciplines such as history, political science and speech no programed materials were available.

Besides not having a sufficient number of programs to evaluate in the fashion called for by the contract with the Office of Education, the procedures for evaluating the programs were not agreed upon nor worked out during the spring, summer and fall of 1964. In the third meeting of the Liaison Committee in May of 1964, the question was raised about the advisability of testing many programs qualitatively versus testing a few programs quantitatively and in depth. It was decided at that meeting to test fewer programs in depth. At that meeting it was also agreed upon that the Director would visit each of the colleges to display the programs that were available for evaluation. It was not, however, decided how these programs would be evaluated. That is, the evaluation design was not clearly thought through and agreed upon. Subsequent events indicated that the lack of clarity of an evaluation design was one of the major handicaps in obtaining useable results from the evaluations that were conducted on commercial programs.

During the summer and fall of 1964 the Director contacted GLCA faculty members who were interested or who might become interested in evaluating commercial programs and setting up with them the procedures for doing so.

In order to coordinate the evaluation project Dr. Donald Beane of the Department of Education of the College of Wooster was engaged by the project to serve as evaluation coordinator for the GLCA in Ohio during the summer and early fall of 1964. During this time he contacted the evaluators and helped them set up their designs as carefully as possible. The Project Director coordinated the evaluation of commercial programs in the Indiana and Michigan colleges of the GLCA.

METHOD

An attempt was made to set up a common format in which all of the commercial programs would be evaluated. The attempt was also made to use common instruments for the collection of data wherever possible. To this end, each evaluator was given an instructor's worksheet in which the design of the evaluation procedures was outlined. Each evaluator was also given an *Instructor Program Evaluation Form*. A questionnaire called *A Student Reaction Questionnaire* was used by all of the evaluators to gather the subjective reactions of the students of the programs that were being evaluated. (See Appendix B-2)

The Instructor's Worksheet contained the identification data of the name of the instructor and department, his institution, the name of the program to be tested, the course in which the program was to be tested and the number of students who would take part in the evaluation.

Next the evaluator in discussion with either DeHaan or Beane decided on what kind of a hypothesis or evaluation question would be studied. The three options were (1) the program as a primary teaching device, (2) the program as supplementary, or (3) a comparison of one program to another. Any important assumptions that were made about the nature of the program or the nature of the subjects were spelled out.

The experimental and control groups were then defined in terms of the number in each group; the manner of selecting subjects for each group either by ordinary college selected sectioning procedures, random selection, or stratified random selection; and the selection variables used in selecting the subjects such as by sex, SAT scores, achievement test scores, grade point average, or grade level in college..

The independent variable, that is, what the instructor would do, was then defined as carefully as possible. The instructor was asked to name the dates during which the evaluation would be carried out. He was then asked to administer and control the following variables.

(a) Supervision of students, what kinds of questions would be answered, what kinds of help would be given.

(b) Motivation and control of competitive factors such as grades and tests.

(c) Control of unscheduled use of programs to avoid contamination arising therefrom.

(d) Control of time spent on program--free versus restricted time.

(e) Control of experimenter bias -- verbal and non verbal communication of instructor's attitudes toward the program.

(f) Determination of use of program; how to handle differences and individual speeds in working through the programs.

(g) Use of supplementary materials.

These variables were considered not only for the experimental group but also for the control group where these were used.

The instruments to be used in the evaluations were also discussed and agreed upon. Whenever possible, pre and post tests were used to measure achievement from the program. Time sheets and other records of utilization were also suggested to get an estimate of the efficiency of the student's use of the programs. Student Program Evaluation Questionnaires, already mentioned, were used to capture the attitudes of the students toward the subject matter of the program. The Instructor's Program Evaluation Form was also used to obtain the instructor's attitude toward the program. (See Appendix B-1). A roster form for recording and summarizing data such as the grade point averages of the students, their SAT scores, and other information was used to get a description of the population.

Provision was made for obtaining clerical assistance and for recording the amount of clerical assistance required. Finally, a deadine was set and agreed upon for completion of the evaluation projects.

The list of evaluators of commercial programs, their departments, colleges and the programs evaluated are given below.

1. Mary Lane Charles
   Department of French
   Earlham College
   French Phonetics - by Eliane Burroughs, Chicago: Encyclopaedia Britannica Press.

2. Dean Dillery
   Department of Biology
   Albion College
   Cells: Their Structure and Function by Marta Zaborska and Frances Unger, Meade, Chicago: Coronet Instructional Films, 1963

3. Larry Hackstaff
   Department of Philosophy
   Wabash College
   Class Logic by Blyth and Jacobson, New York: Harcourt, Brace World, Basic Logic and Auto-text.

4. Edward Kormondy
   Department of Biology
   Oberlin College
   Introduction to Genetics by Edward Kormondy, New York: McGraw-Hill, 1964

5. Ira London
   Department of Psychology
   Denison University
   Analysis of Behavior Parts I & II - James Holland and B. F. Skinner, New York: McGraw-Hill

6. John Reinheimer
   Department of Chemistry
   College of Wooster
   Programed Supplement for General Chemistry Vol I & II, by Gordon Borrow, et. al. New York: W. A. Benjamin Inc.

7. Fernando Rodriquez
   Department of Romance Languages
   Ohio Wesleyan University
   French Phonetics - by Eliane Burroughs, Chicago: Encyclopaedia Britannica Press.

8. Ruth Smyth
Department of Mathematics
College of Wooster
Analytic Trigonometry - by David C. Luckham, Chicago: Encyclopaedia Britannica Press.

9. Donald Van Liere
Department of Psychology
Kalamazoo College

with
Miss Barbara Arnold
Senior Psychology Major
Analysis of Behavior by James Holland, B. F. Skinner, New York: McGraw-Hill

10. Robert Weiss
Department of Speech
DePauw University
Parliamentary Procedure - Lehman, Garden City, New York: Doubleday and Co.
Parliamentary Procedure - Gray and Rea, Chicago: Scott, Foresman and Co.

11. Joseph Wetmore
Department of Education
Ohio Wesleyan University
Statistical Measures - Gorow, Chandler Publishing Co.
Basic Statistical Concepts - Bradley and McClelland, Scott Foresman and Company.

12. Dorothy Whitted
Department of English
Ohio Wesleyan University
Effective Writing
Smith and Stapleford, Garden City, N.Y.: Doubleday and Co.

13. Francis Williams
Department of Chemistry
Antioch College
Systematic Naming of Aliphatic Compounds - by O. Theodor Benfey, Earlham College, 1964.

14. Robert Wilson
Department of Mathematics
Ohio Wesleyan University
TMI Algebra Refresher, by Frank C. Gentry, New York: Teaching Materials Corp.
Programed Beginning Algebra, by I. Drooyan and Wm. Wooton, New York: Wiley.
Analytic Trigonometry, David C. Luckham, Chicago, Encyclopaedia Britannica Press.

RESULTS

Summary of Responses on Instructor Attitude Questionnaire

Each of the professors who conducted an evaluation study of one of the commercial programs filled out a questionnaire. The questions were designed to sample instructor attitudes about the value of the program as a teaching device. A tabulation was made of the responses on the sixteen instructor questionnaires which were completed, and a summary is presented below:

Question # 13: In your opinion does the program actually teach what it claims to teach to the students for whom it is presumably designed?

10 Yes   0 No   5 Partly

We see that a large majority felt the programs accomplished their objective of teaching subject matter to students. However, the instructors did find weaknesses in the programs as the following series of questions indicate.

Question # 10: Are there errors in the content?

6 Yes   10 No

Question # 11: If you found errors in the content, were they major or minor?

0 Major   4 Minor   2 Both

Question # 12: Are there any technical program errors, e.g. poor directions, points of confusion, etc.?

2 Yes   13 No

An interesting observation from Questions # 10 and # 12 is that the instructors found more fault with the content of the programs than with the manner in which the content was presented.

Question # 14: Are the responses that the student is required to make token or real? (That is, do the frames merely require mechanical filling in or do they require thought and/or problem solving?)

4 Mostly token responses   11 Mostly real responses
1 Spotty, some of both

Question # 16: Evaluate the pace of the program.

0 Too fast   4 Too Slow   3 Uneven   9 About Right

Question # 18: Does the student get a sense of direction, where he is going, from the program?

9 Yes 0 No 6 at times

Question # 19: Can the student easily review the programed material?

10 Yes 4 No 2 At times

The responses indicate that instructors were in general favorably impressed with the manner in which commercial programs presented the content.

Then came a series of questions concerning the practical aspects of programed materials.

Question # 21: Does the importance of the content covered justify the amount of time required of the student?

11 Yes 5 No 1 Uncertain

Question # 22: Does the program save the instructor time?

10 Yes 4 No 2 Uncertain

Question # 23: Is the program justified in terms of its cost?

7 Yes 4 No 6 Uncertain

In spite of some reservations about the quality of the programs evaluated, the instructors indicated they did not know of better programs available.

Question # 25: Do you know of better or similar programs on comparable material?

2 Yes 13 No

Finally, a concluding question about general attitudes toward programed materials was this:

Question # 31: In summary, what is your overall reaction at this time to using programed material in this course?

8 Very positive, would like to use similar material again.
3 More positive than negative reaction to it.
0 Indifferent to using it.
4 More negative than positive reaction to it.
0 Very poor, would object to using it again.

Methods and Results of Individual Evaluation Projects

Below is a description of what each evaluator did in evaluating his program, how well the students achieved with the program, the student's evaluation thereof, and the instructor's evaluation of the program.

1. Professor Mary Lane Charles of the Department of French, Earlham College evaluated Burrough's French Phonetics, a TEMAC program. The program was compared against Professor Charles' own procedure for teaching French pronunciation.

a. Method. In the first week of the semester in the fall of 1964, Professor Charles gave one group the TEMAC program and the second group her own material on French pronunciation. There were 5 students in the experimental group and 5 students in the control group.

The experimental group was told how to use the program. Professor Charles did not drill the students in French Pronunciation, only answering their questions. They were graded on French pronunciation. The programs were used only in the language laboratory where they were kept. Students were given as much time as they needed on the program and were asked to keep record of their time.

There were 5 students in each group. They were selected by ordinary college selection procedures. The instructor, however, found out from the students which ones had previously had contacts with French and tried to equate the number of them in each group. She also tried to balance the group in terms of sex and grade level in both groups.

The main instruments that were used were a pre and post test consisting of a standard French paragraph. The comparison of the groups was made on the basis of gains on the pre and post tests.

b. Results

Group	N	Pre test Means	Post Test Means	Gain Score Means
Program	5	53.2	78.2	25.0
Control	5	59.2	78.4	19.2

The test used was a 20 item pronunciation test scored on the basis on 0,1,2 for each sound. This was evaluated by three persons, a French student assistant, a French teacher and the regular instructor, making a total possible score of 120.

Both groups showed appreciable gain in scores from pre test to post test. No test of significance of defferences in mean gain scores was made.

c. Instructor Evaluation

The instructor described her attitude toward programed material in the following words, "I like the organization of the material. It is well presented by the speaker. The field of French pronunciation, within the scope of this undertaking, is well covered. The steps are small enough for the student to understand each one. The material is repeated in different ways to furnish a review of previously presented material. I do not see how it could be improved."

Her overall evaluation and reaction to the program was very positive and she would like to use similar material again. She added, "For best results a course in beginning French should have supplementary work in the language lab with a teacher correcting mistakes in pronunciation. I do not think that this program alone is adequate for teaching French pronunciation to beginner."

2. Professor Dean G. Dillery of the Department of Biology, of Albion College, evaluated the program entitled Cells: Their Structure and Function, produced by Coronet.

a. Method.

The program was used to supplement the regular materials in the course. A total of 120 students were used in the experimental group. The students were divided into two groups of two laboratory sections each. Sixty-four students were in the control group that was made up of two laboratory sections. These students were selected by ordinary college sectioning procedures.

Two lab sections of the experimental group were told how to use the program and sections of the program were assigned for five units of laboratory work. No mention, however, was made of the program in any of the lecture sections. Another two laboratory sections of the experimental group were told that the program was available in the library and were reminded once that it was furnished for their use. Students were not told how to use the program nor was the program assigned at any time. The two laboratory sections of the control group were not told about the program by any of the staff members involved in instructing them, except that the investigator did and then only when the student came in and asked specifically about it.

The programs were placed on closed reserve in the library and time cards were kept on each program. A record of the use of the program by every student was kept, including how long he used it.

It was assumed that if the students considered the program beneficial they would continue to use it through all five sections of the work it covered. It was also assumed that if students considered the program beneficial they would tell their friends who had not previously been told about it.

The variables used to measure the effectiveness of the program were the number of students who used the program, the amount of time the students used the program as recorded by the librarians, their grade point average and their scores on the hourly quizzes that covered the material in the program.

b. Results

The number of students using the program was compared with the final semester grades.

Group	Semester Grade Distr.	No. in Group	No. Using Program	Percent
Experimental Gp. 1 (Program Assigned)	A or B	23	8	35%
	C	18	9	50%
	D or E	11	0	0%
Experimental Gp. 2 (Program Mentioned)	A or B	30	6	20%
	C	14	3	22%
	D or E	13	2	13%
Control Gp. (No Mention of Program)	A or B	24	0	0%
	C	34	2	6%
	D or E	3	0	0%

A greater percentage of the C students in all three groups took advantage of the program. The D and E students for which the program was intended made little or no use of the program.

One noteworthy observation is that students of average or better in achievement were more likely to read material if it was assigned explicitly rather than merely mentioned. Requiring the program to be read had no positive effect on the D and E students.

c. Instructor Evaluation

B

The instructor mentioned that he had not used programed material before. He described his initial reaction to programing as favorable. He said it was "fine for some things and not so fine for others." He went on to say that the material was aimed at the high school level and was much too elementary for college freshmen. "Therefore, it was of little, if any, value." He mentioned that the program did cover essentially the same material that he desired to cover in the course, but did so too superficially.

3. Professor Larry Hackstaff, Department of Philosophy, Wabash College, evaluated two commercial programs.

a. Professor Hackstaff made the following report on his used of the programed text, Basic Logic and Auto-Text (RCA), during the spring semester of 1964.

In response to the question of whether he had ever used programed material before, Professor Hackstaff indicated that this was his first experience with programed material. He used it as a primary teaching device in place of a textbook.

His initial attitude toward programed instructional material was uncertain. He described himself as being "neutral". "I wanted to see how the material would work."

In using his own words in giving his reaction and evaluation to the programed material, he said the following, "Basic Logic is unsatisfactory as a teaching device in logic. It fails to teach the students how to make inferences since it presents the material in such a mechanical way. This leaves the students to expect an automatic decision procedure for logic in general -- a procedure which is not available. The text also contains a number of logical howlers which even elementary students were able to detect. My estimate is that the author of the text is not a professional logician."

In addition, Professor Hackstaff indicated that there were errors in the content of both the major and minor variety. Although the program actually teaches what it claims to teach, Professor Hackstaff indicated that most of the material in Basic Logic is of no use for developing a sophisticated course in logic.

He indicated that the importance of the content did not justify the time required of the student to go through the program. Neither did the program save the instructor time, nor was the program justified in terms of its cost.

When asked whether a similar program was available, or better program, Hackstaff indicated that he thought Professor Morton Schagrin's program, Language of Logic, would be a better one.

When asked to compare the program to both textbook and lecture, Professor Hackstaff indicated that he would prefer both the text and the lecture. "I would not recommend the RCA text to anyone for any purpose."

b. Prof. Hackstaff made the following report on Class Logic, a programed text by John Blyth and Jacobson, which he used during January, 1965.

The program was used as a primary teaching device in the place of a textbook. His general reaction to the program was: "*Class Logic* was in most ways superior to *Basic Logic*. For the first five or six sections, both students and I were favorably impressed with the book, but by the end of the semester almost all of us were of the opinion that the material was being introduced at a painfully slow and mechanical rate. Good students reported being bored by the repetitiveness and poor ones often simply did not do the frames. The text covers too little of the subject matter of logic and takes too long in doing it."

In answer to the question, does the importance of the content covered justify the amoung of time required of the student, Prof. Hackstaff answered "no". Furthermore the program did not save the instructor time and probably was not justifiable in terms of the cost for the purposes of Prof. Hackstaff's course.

In summary, Hackstaff said the following: "I have yet to be convinced that the programed methods will substitute for a general technical text in the subject of symbolic logic except for introduction of special material. I agree with John Blyth that it may be an error to try to program an entire logic course. Programed material on aspects of logic or on material of an appropriate sort (e.g. symbolism, application, variation on standard logic, etc.) would seem to me to be desirable. Morton Schagrin's program, the *Language of Logic*, covers a limited and clearly demarcated field and is a good start (See Chapter 3 for a description of the program.) But my experience with running an entire course on the basis of programs plus supplementary material (mimeographed) indicated that little is to be gained and something is to be lost by structuring the course around presently available material."

cf

4. Professor Edward J. Kormondy, Department of Biology, Oberlin College, compared his own programed text, *Introduction to Genetics*, McGraw-Hill Company, 1964) and a traditional text (Weisz: *Science of Biology*, McGraw-Hill Book Company, 2nd ed., 1963) as to their effectiveness in independent study. In addition, both independent study techniques were compared with the traditional lecture methods employed in the course. The experimental design was conceived as a test of the null hypothesis that "Achievement based on test gain scores will show no significant differences."

underscore

a. *Method*

The material covered by each group was the same: a review of mitosis, a treatment of meiosis, and a survey of fundamental Mendelian concepts in genetics. This material is typically covered in three 50-minute lecture periods and one 3-hour laboratory period; the more sophisticated and complex aspects of genetics (physiological, biochemical, and eugenics) are treated in a additional block of three lectures.

The treatment administered to each group was a follows:

Group X - Independent study using programed text.
This group did not attend the three initial lectures on genetics and was assigned 15 lessons in the programed text constituting an anticipated 9 hours of study; the rule of thumb in this study time is the oft-recited 2 hours study for each class hour.

Group C-1 - Independent study using regular textbook.
This group did not attend the three initial lectures but was referred to the appropriate pages of their textbook for independent study.

Group C - Non-independent study.
This group attended the three initial lectures and used the textbook in each student's customary fashion. They were encouraged not to alter their ordinary learning-study pattern.

The size and composition by class of each group is given in Table 1.

exam
s

Pre test and post test examinations were administered unannounced just prior to and immediately after the experimental period; the same test was used for bothexaminations. The unannounced testing allowed for an assessment of the announced examination. Performance on the genetics portion of the final examination was tabulated as was information relative to subsequent sources of experimental contamination (use of program by non-program students, etc.). Analyses were made only on paired pre test and post test scores, thereby eliminating an additional 62 students who had taken only one or the other test.

b. Results

Table 2 shows the mean (average) pre test and post test scores and the mean gain scores computed as the difference between pre test and post test scores for each group. (In the table, the symbol σ = the standard deviation of the mean, a statistical concept, describing the spread or dispersion of scores. It may be interpreted as follows: in a normal distribution of scores about 2/3 of all scores fall within one standard deviation of the mean. For example, the pre test score on Group X is 29.6 ± 16.7; then one σ or about 2/3 of all test scores would be expected to fall between 12.9 and 46.3. The larger the value of σ, the greater the spread of scores).

Inasmuch as the groups were not initially uniform, an analysis of covariance was applied to determine the statistical significance of differences in the mean gain scores. This analysis was also applied within each group to assess differences between freshmen and sophomores.

and upperclassmen. The F and P values so derived appear in Table 3 and show the following results: 1) Group X is significantly different from both Group C and C-1; 2) Group C and C-1 do not differ significantly; 3) there is no significant difference between freshmen and upperclassmen in any group.

In addition to the data on test scores, the mean number of hours of study spent by each group was computed from time records (Table 2.) Correlation analysis of study time and mean gain score showed no significant correlation (Table 2) in any group although it approaches the 5% level of significance in Group X.

c. Discussion and Interpretation

The experimental group using a programed textbook in independent study performed significantly better than either of the control groups in learning a given block of material. Although this higher test score performance was accomplished by a greater expenditure of time, it is to be noted that no correlation was found between study time and improvement in any of the three groups. The function of study time in learning is intrinsically highly variable at any rate.

It can be argued that had the non-independent study group (C) studied as for any exam, its performance would have been better; while this is doubtless true, it is also quite obvious that there is a marked difference between the active learning required in programed learning and the passive learning of a lecture situation. This distinction is more striking in comparing the "active" learning of the two independent study groups. It is reasonable to conclude from the difference in these latter groups that for effective and efficient independent study, the materials need to be adequately and appropriately designed. There is no evidence here to suggest that such adequately designed materials need be of the programed or "teaching machine" sort.

The results strongly indicate that this particular part of introductory biology can as effectively be taught via independent study. The same conclusions were drawn from the earlier Oberlin-Earlham study (Kormondy and Van Atta, 1962). There are undoubtedly other parts of the subject matter of general biology (and other disciplines) which could be similarly treated if suitable materials were available; at the moment there are none although several are being prepared by competent biologists elsewhere.

Assuming a somewhat comparable survey of genetics is conducted another year, it can be confidently recommended that the material on mitosis, meiosis and basic mendelian genetics be self-taught through a programed text (or other suitable self-instructional materials) and that the three lecture periods heretofore used for this material be reassigned. Two lecture periods might be waived in partial compensation for the independent-study time, and the remaining lecture used to allow more "breathing space" for the more sophisticated, experimental, and perhaps controverisal areas now squeezed into three lectures.

Table 1: Class distribution (as percentage of total) in experimental and control groups.

Group	N	Freshman	Sophomore	Junior	Senior	Special
X	71	59.2	28.2	7.0	4.2	1.4
C-1	86	75.6	19.8	2.3	2.3	0.0
C	116	32.8	53.4	8.6	4.3	0.9

Table 2: Pre test and post test scores, mean gain scores, study time and correlation of study time and improvement.

Group	N	Pre Test (x +0)		Post test		Mean Gain Time	Time x	Time o	Correlation Coefficient of Improvement Time
X	71	29.6	16.7	70.5	20.6	40.9	9.4	3.8	.36 (NS)
C-1	86	33.7	17.7	56.7	15.6	23.0	4.5	2.4	-.06 (NS)
C	116	31.2	19.2	59.2	16.6	28.0	6.0	2.8	.08 (NS)

poor

Table 3: Results of analysis of covariance of gain scores (5% rejection level)

Group	F value	Significance
X vs C-1	30.26	P .0001
X vs C	18.80	P .0001
X vs C-1	2.74	NS
X: freshmen vs upperclassmen	2.89	NS
C-1: Freshman vs Upperclassmen	0.04	NS
C: freshmen vs Upperclassmen	0.88	NS

check

d. Student Evaluation

This was the first experience with programed instruction for two-thirds of the students in the experimental group. They reacted favorably to this method of instruction. Forty-four thought it was a very positive learning experience or had a more positive than negative than negative reaction, while eighteen had a negative reaction.

The students were evenly divided on whether they preferred lectures or a program for presentation of material. However, without an instructor, twice as many preferred programed materials to the use of a regular textbook.

A majority considered that what they learned from the program was worth the time spent on it. They felt the program gave them a sense of direction, the pace of the program was about right most of the time and the step size of the program was about right most of the time.

Thirty-four of the students indicated they could easily review the programed materials while ten said they couldn't and 17 were uncertain.

When asked to characterize programed materials as they experienced it, the following responses were checked most often.

No.	Responses
36	It was mechanical
35	In spite of its disadvantages, I learned much
29	It gave me a feeling of making progress
23	It made me think

In the group using the textbook, the most frequent responses to this question were as follows: mechanical - 29, impersonal - 27, made me think - 37.

We see from this comparison of methods of instruction that the personal touch of a good instructor is still appreciated by students more than a program or text.

When asked how programed instruction should be used in college, 41 said "as a supplement to textbooks and lectures", 35 responded "to bring students up to the starting level in the course". Only 6 thought programed instruction should be used as a primary teaching device in place of lectures.

In summary, about two-thirds of the programed text group (Group X) responded favorably to that approach although they were equally divided as to their preference of lecture vs. programed material.

parte 1

In spite of the mechanical and impersonal aspects of the technique, which many felt to be the case, most found that it gave a feeling of progress and of accomplishment.

The independent-regular textbook group (Group C-1) was less favorably inclined toward that approach (somewhat over half) and seemed to be less positive of its effectiveness. The reacions of both subdivisions of the traditional group (C) are, in general, parallel to these attitudes although they are more favorable toward their particular method of presentation.

e. Instructor Evaluation

Professor Kormondy indicated that he had used programed material before this time. Heparticipated in some of the original research and development of programed material in general biology in 1959 and 1960.

Prior to evaluating these materials, for GLCA, he considered himself favorably disposed toward programing. He said, "Not in general, but under specific instances, not as a substitute for teaching."

In his opinion, the importance of the content justified the use of the program. The program does save instructor's time and its use is justified in terms of its cost, at least by current book prices.

In summary, his overall reaction to this programed material at this time is one of very positive nature. He would like to use similar material again.

5. Professor Ira London, Department of Psychology, Denison University, conducted a research project using the commercial program, Analysis of Behavior Parts I and II, by Holland and Skinner.

a. Method

The study was designed to test differences in achievement using the published programed text versus the adaptation of the text in which material was written inconventional prose style with no blanks to fill. The contents of the two programs were the same. The programs were the primary method of instruction during the study. Approximately one hundred students used the published text while the same number used the adapted text in a unit which is part of the freshmen psychology course.

In the fall of 1964, a partial field study of the commercially available programed text, The Analysis of Behavior (Holland and Skinner, B.F., 1961) was conducted at Denison University. This text is a linear program, wherein the student is presented with a fixed sequence of stimuli, to which he responds with a construction-type (fill-in-the-blank) answer. The format permits the student to compare his response with the correct answer which appears on the next page and precedes the next stimulus panel in the sequence.

The stimulus material employed in this study was part of the assigned reading in the Introductory Psychology course. Students in six sections of this course served as subjects. Half the randomly selected students in each section were instructed to study Parts I and II of the programed text, pages 1 through 71. The remaining students were given an adaptation of this material which presented all the concepts included in the program in a conventional textbook format.

The adaptation was constructed by essentially eliminating much of the redundancy present in the programed text. The blank spaces in each item were replaced with the correct words or phrases presented in the program. These were underlined. Thus, this format did not elicit any answer-type responses from the student. The number of items evoking the same response and the number of examples illustrating a concept were reduced. Information from exhibits preceding the sections of the program was interspersed at appropriate places in the text of the adaptation. When necessary, the order of items in the program was changed to permit greater continuity. The eleven sections thus constructed were reproduced on fifteen single-spaced mimeographed pages.

All materials and instructions were distributed during the first class meeting of the semester. *S*'s assigned to the program group (Group P) received the following instructions:

> This semester the Psychology Department is conducting a partial field study of the programed text, *The Analysis of Behavior*, which is part of the assigned reading in Psychology 101. This study is sponsored by the Great Lakes College Association Programed Instruction Project.
>
> An adaptation of Parts I and II of the programed text will be presented to about half of the students enrolled in this course. This adaptation presents all the concepts included in the programed version in a conventional text book format.
>
> Participation in this study will require very little special effort on your part. All students may purchase the text, and all students are responsible for the assigned material. However, those students receiving the adaptation will be instructed not to study or look at Parts I and II of the programed text. Those students who do *not* receive the adaptation are instructed *not to study or even look at this adaptation*. Remember: study Parts I and II of the programed text exclusively. Do not study the adaptation. Once again, rest assured that the programed

> text and its adaptation are merely two methods of presenting exactly the same material.
>
> You will be tested on all this material as part of the regular testing sequence in this course. A half-hour multiple choice quiz, covering the material in this adaptation, will be given eight days hence.

In addition to the mastery test scores, S's submitted information on time spent studying the material. These data were gathered following the test administration. General instructions were as follows:

> Your participation in this study imposes no restrictions or limitations on your amount, method, and pattern of study. However, we would like you to keep track of the amount of time you spend on this material, according to the instructions on the following page. Please be honest and accurate in recording this information. Whether you study a little or a lot will have no direct bearing on our evaluation of you as a student. Your final grade will reflect your performance in labs and on exams exclusively.

The instructions for time keeping provided for the recording of ten separate study sessions of each of the eleven sections. S's were informed that they might study each section as frequently as they wished and that the sections need not be studied an equal number of times. Conventions were established for timing partial readings and reviews. When, for any reason study times were estimates, S's were instructed to record such estimates according to a schedule reproduced on the instruction sheet.

All instructions for S's in the adaptation group (Group A) appeared at the beginning of the adaptation. These were identical to those given to Group P, with one exception; S's were informed that they could purchase the programed text, but were cautioned to avoid reading sections 1 through 11. All materials were collected following administration of the mastery test. Approximately 90% of the students returned the adaptation and/or time keeping sheet.

The mastery test consisted of 33 multiple-choice questions, with sampling from all of the 11 sets or sections included in the assignment. The test was administered during regularly scheduled class periods. S's were allowed the entire 50 minute period in which to complete the test. S's were instructed to answer every question. The test score was the total number of correct responses.

b. Results

Two measures were derived from the present study: (1) mastery test score; and (2) total study time in minutes. The mean difference

E

in test performance between groups P and A was evaluated by use of the t-distribution. Differences between treatment groups with instructor held constant were similarly evaluated. Means and standard deviations and t-tests, are presented in Table 4 below. As indicated in the table, none of the differences in test performance were significant.

see copy Pg 146 Draw lines

Table 4:

Means, S.D.'s and t-tests for Mastery Test Performance
Groups P and A

Instructor	Group P			Group A			t Tests		
	n	$\bar{x}$	S.D.	n	$\bar{x}$	S.D.	t	d.f.	P
1	31	25.5	3.87	38	26.4	4.02	.95	67	N.S.*
2	52	24.9	3.68	50	25.6	4.22	.90	100	N.S.
3	21	26.0	4.55	20	24.8	3.55	.95	39	N.S.
All Sections	104	25.3	3.91	108	25.7	4.00	.74	210	N.S.

* Non-significant

Analyses identical to those described above were applied to the study-time data. Table 5 summarizes these results. Despite considerable skewness in individual distributions and apparent heterogeneity of variance between groups, no transformations were applied to these data. As indicated in the table, however, all of the mean differences were statistically significant. In each case, S's in Group A studied significantly less, on the average, than did Group P S's.

Table 5:

Means, S.D.'s and t-tests for Study Time Data
Groups P and A

Instructor	Group P			Group A			t-tests		
	n	Mean	S.D.	n	Mean	S.D.	t	d.f.	P
1	24	224.4	106.4	37	141.5	81.6	3.25	59	.01
2	50	201.1	68.1	47	127.3	65.1	5.47	95	.01
3	20	259.8	156.8	20	142.6	52.4	3.17	38	.01
Total	94	219.6	104.0	104	135.3	69.0	6.64		.01

c. **Discussion**

One major result of this study is, that no difference in mastery was found between the group (P) instructed to study a specified portion of the programed text and the group (A) presented with identical material in a standard textbook format. This result lends support to the thesis that elicitation of an overt or covert response during study is not a necessary condition for subsequent demonstration of mastery. This conclusion of course, is based on a comparison of group means. This independent-groups design does not permit analysis of the individual case. That is, we have no opportunity to compare the test performance of a given subject on different material presented with both formats, one which elicits specific responses (program) and one which does not (adaptation). Analysis of this question requires a subjects-as-own-controls design with independent procedures for equating difficulty level of both stimulus materials and mastery test.

The second noteworthy result was that significantly less study time, on the average, was spent by S's in Group A than Group P. With study time as a criterion, it seems reasonable to conclude that the present adaptation was a more efficient method to achieve a given level of mastery. However, generalizations beyond the specific paradigm and stimulus materials employed in the present study seem unwarranted. Selection of different stimulus materials might result in significant differences in test performance (in either direction) and reduction or reversal of the study time effect.

This study time differential seems attributable to a number of factors, working singly or in combination. The present research was not sufficiently detailed to determine which of these factors was operative. The most obvious interpretation is that the time differential reflects the fact that S's in Group A had approximately half the amount of reading required for Group P S's. That is, the result may be a direct result of the reduced redundancy.

An alternative explanation suggests that a considerable portion of the time difference may be attributable to the greater compactness of the adaptation (15 pages versus 71 for the program). Use of the former would involve less sheer page-turning time and fewer anticipatory attending responses. That is, the difference may be due to a less-than-optimal program format. Related to this alternative is the possibility that the difference reflects the relatively greater efficiency with which sections could be reviewed by S's in Group A. The result would be attributable to differences in review time, rather than in initial reading or study time. Finally, the observed difference may be due to the fact that S's in Group P were required to select a response, construct that response and compare it with the correct answer. No such operations were performed by Group A. The result may therefore be a function of differential response time.

These results suggest, that further research in which the entire programed text, The Analysis of Behavior, is adapted as above may serve to isolate the variable(s) responsible for the reported time difference. Indeed, the conversion of linear programs into more conventional formats and subsequent field tests thereof may lead to the isolation of critical variables in the writing of maximally efficient programs and/or conventional text books.

6. Professor John Reinheimer, Chemistry Department, College of Wooster directed a research project using the commercial program, Programed Supplements for General Chemistry Volume I and II, by Barrow.

a. Method

The study was designed to compare achievement on a unit examination; one group used the programed materials while a second group received individual help by the instructor. The instruction for both groups was supplemented by regular classroom instruction. Approximately 15 subjects were in each of the two groups.

At the end of the first unit of work in the Freshman Chemistry course, the students with the lowest thirty scores on the unit test were selected for the study. Approximately five sections of the course were involved so students were matched according to the scores on the first unit test and by sections. Approximately two weeks before the second unit test, students in Group A were given the opportunity to use the programed materials covering the content of the second unit for review purposes. Those in Group B were given the opportunity and encouraged to come in to get extra help from the instructor and to prepare for the second unit test.

Two weeks before the unit test number three, the treatment was reversed. Group A students were encouraged to get extra help from the instructor and students in Group B were given the programed materials to study in preparation for the exams.

Test scores on test 2 and test 3 were compared for each matched pair to see which treatment resulted in greater achievement. The time spent on the programed materials and time spent receiving additional help by the instructor were recorded for each student in the study.

b. Student Evaluation

Eighteen out of twenty-two students indicated that they had never used programed materials before. The overall reaction to using programed material in this course was favorable for 16 students, indifferent for 4 and unfavorable for only two.

The group divided evenly on preference for programed materials or regular textbook. The preference for lectures rather than programed materials was an overwhelming 13 to 1. Five were indifferent.

Most of the students indicated that what they learned from the program was worth the time spent on it. They felt it gave them a good sense of direction and the pace of the program was about right most of the time. The majority also felt that material could easily be reviewed.

When asked to characterize programed material as they experienced it, the two responses checked most frequently were as follows:

No.	Response
10	It gave me the feeling of making progress
9	It speeded up my learning

The students felt that the best way to use programed instruction in college was as a supplement to textbooks and lectures. The second choice was for remedial work when the student falls behind.

Seven students indicated the use of programed materials favorably affected their attitude toward the subject matter of the course. Thirteen said it had no appreciable effect and only one said it had an unfavorable effect.

c. Instructor Evaluation

The instructor had never used programed materials before. The program was used for remedial work when the student fell behind. It was also used for supplemental drill.

The instructor's initial attitude toward programed instruction was favorable. His comment on Barrow was the following, "Barrow is very good." He found no errors in the content and no technical errors in the program. The instructor felt that the importance of the content covered by the program justified the amount of time required by the student. He indicated that the program saved the instructor time and the program was justified in terms of its cost, as well. He would like to use similar material again.

7. Professor Fernando Reodriquez, Department of Romance Languages, Ohio Wesleyan University conducted a research study in his first year French course using the commercial program, TEMAC French Phonetics, by Burroughs.

a. Method

The study involved supplementary use of the material including tapes versus the use of a basic text in French which includes tapes for use in the language laboratory.

The experimental group was a class of seven students who took the course in the summer of 1964 and used a text which did not have accompanying tapes. The TEMAC programed text and tapes provided the supplementary phonetics study which the students needed. A comparably sized control group was randomly chosen from those students taking the course the fall semester of 1964. This control used a basic text which included the tapes for phonetic drill.

A tape of conversational French which students were asked to comprehend served as the pre and post test for both groups. The experiment for each group lasted six weeks.

b. Results

The comprehension of the tape of conversational French which served as the pre and post test was evaluated subjectively by the instructor, using a 10-point scale.

Group	N	Pre test Mean	Post test Mean	Gain Score Mean
Program	7	3.6	6.3	2.7
Control	7	3.6	6.9	3.3

Both groups showed improvement over the six weeks period from using individual instruction through programed tapes or regular language lab. However, there is no appreciable difference between the two groups in the amount of improvement as measured by mean gain scores.

c. Student Evaluation

In the experimental group this was the first experience with programed material for six of the seven students. Four expressed an unfavorable overall reaction to the programed materials used in the course, one reacted favorably and two were indifferent.

The students believed that the place for programed material in college was for remedial work when the students fell behind. Five of seven checked this response.

As a way of learning, five of the group felt that programed material was less effective than a textbook or other materials they had used. The students worked with the programed materials an average of 13.5 hours.

"Compared with what you learned from the program, was it worth your time?" Three answered no, three were uncertain and only one said yes.

The general comments students made on the back of their questionnaires indicated that the programed materials were not useful for the beginning French student.

d. Instructor Evaluation

Rodriquez had not used programed material before. He indicated that his initial attitude toward programed instruction prior to testing the material was favorable. He went on to evaluate in his own words thus, "I experimented with the TEMAC program in French Phonetics this summer because the textbook used did not provide tapes for language lab use. I thought that this programed material would be of some help to the students since the introductory booklet claimed that the program was designed for the beginning student as well as the advanced student. The results of the experiment were disappointing for the following reasons:

(1) The program content deals with phonetics whereas the ideal program for the elementary class should be on pronunciation.

(2) The student was required to learn the phonetic symbols which added to the already heavy load of new material to be learned.

(3) The time allowed on the tape for repetition and responses remained the same even though the material increased in difficulty.

(4) The students expressed difficulty in making an association between the programed work and the work in the classroom.

(5) The arrangement of the programed material itself is faulty in places and especially confusing at the beginning.

In general, the results of the TEMAC material with an elementary class were unsatisfactory; however, I feel the program would be more successful when used by an advanced student working independently or in conjunction with an advanced class in conversation or phonetics."

8. Professor Ruth Smyth of the Mathematics Department, College of Wooster, directed a research project using the commercial program, TEMAC Analytic Trigonometry.

a. Method

The study was designed to test if there was any difference in achievement when the primary means of instruction was by programed materials or by conventional lecture and textbook. The period of the study was the entire first semester and involved two groups of 25 students each using programed materials exclusively, and two groups of 25 students each using instruction by large class lecture and small discussion sections. The students were chosen for the study on the basis of the mathematics placement test administered at the beginning of the academic year. Students scoring below a given cut-off point were recommended for the course in Analytic Trigonometry.

E

The students in the four groups were matched as closely as possible on the basis of placement test scores, sex and year in college.

The two experimental groups were given the programed text and told to work through the program to a specific page each week. This work was to be done outside of class with no help by the instructor. Each week a quiz was given on the material and the program assigned for that week. The two control groups met together for mass lectures two periods a week. The third period the two groups met separately for discussion with the instructor and then a quiz was given. Achievement was measured by weekly quizzes, hourly exams, and final exams. The same quizzes, hour tests and final examinations were given all four groups.

b. Results

Group	N	Mean Gain Scores
Program	48	17.16
Lecture	47	8.96
Standard error of Difference		7.67
t-ratio based on Independent Samples		1.17 N.S.

nt9

The data indicate that there was considerable difference in the mean gain scores of the two groups favoring the group which used the program. However, there was so much variability in scores within the groups that the difference in mean gain scores between the control and experimental groups was not statistically significant at the .05 level.

c. Student Evaluation

This was the first experience with programed materials for 41 out of 48 students in the experimental group. When asked what their reaction was to the use of programed material in this course, 16 gave favorable responses while 28 expressed a negative reaction. There was a 2 to 1 ratio favoring the use of a textbook rather than programed materials. The ratio was 3 to 1 favoring the presentation of material by lecture rather than programed instruction.

When asked if they considered what they learned from the program worth the time they spent on it, 17 said yes, 19 said no. One of the major complaints was the difficulty of reviewing the material. Only 12 thought it was easy to review while 31 said it was not.

The students were asked to characterize the programed material as they experienced it. Three responses were checked more than twice as often as the others. These were as follows:

No.	Response
40	It was mechanical
32	It did not hold my attention
31	It was boring

The responses checked most often to the question, "As you see it now how should one use programed instruction in college? were as follows:

No.	Response
32	As a supplement to textbooks and lectures
28	For remedial work when the student falls behind
22	To bring students up to the starting level in the course

Half of the students responding indicated that the use of programed materials unfavorably affected their attitude toward the subject matter while only 5 stated it had a favorable effect. Eighteen said it had no appreciable effect.

In contrast, the group receiving the lectures were 50-50 in their reaction (favorable versus unfavorable) to this method of instruction. A large majority felt the method justified the time spent on it and the material could be easily reviewed.

However, when asked to characterize the methods used in the course, two of the same three responses led the list.

No.	Response
40	It was mechanical
31	It was boring
20	Made me think
20	Did not hold my attention

Seven students said the lectures had a favorable effect on their attitude toward the subject, 15 said they had an unfavorable effect and 21 said they had no appreciable effect.

d. Instructor Evaluation

Professor Smyth indicated that she had never used programed material before. In her own words her reaction to the evaluation of the programed material was as follows: "The Material was poorly edited. There were many errors in the answers. There was no way for students to know what was important. No index was provided and too much 'spoon feeding.'"

CL

She went on to say that the importance of the material did justify the student's spending the amount of time on it required of the program. The program would save the instructor time if he were not required to teach as well as test the material. But she thought the students learned only when there was some teaching done in addition to using the program.

9. Professor Donald Van Liere, with a senior psychology major student by the name of Miss Barbara Arnold, evaluated the effectiveness of programed instruction using the Holland-Skinner program entitled, Analysis of Behavior. The program was tested as a primary teaching device and as a supplementary teaching device.

a. Method

Two experimental groups, each having between 30 and 35 subjects and one control group of 34 were selected. These groups were selected by ordinary college sectioning procedures. They were controlled, however, on the basis of aptitude test scores. Most of the students were freshmen or sophomores.

The first experimental group used the program only. The second experimental group heard lectures on the material and used the program as well. The control group heard the lectures only.

The programs were restricted at the Department of Psychology library and the librarian kept track of the time and the names of students who used the books. The students were required to use it on certain days at certain times.

Pre and post tests on the content of the material were used. Miss Arnold kept a record of the use of the programs.

b. Results

Group	N	Mean Gain Scores
# 1 Lectures only	34	21.52
# 2 Program only	30	30.71
# 3 Program and Lectures	24	30.10

Difference in Means: Groups #2 and #3	.62	
Standard error of difference	1.54	
t-ratio based on independent samples	.40	NS

Difference in Means: Groups #2 and #1	-9.20	
Standard error of difference	1.04	
t-ratio based on independent samples	-8.85	$p < .01$

←
se
co,
Page

Difference in Means: Groups #1 and #3	-8.58
Standard error of differences	1.48
t-ratio based on independent samples	-5.80 $p < .01$

The data indicate that while students in all groups learned during the study, the students in Groups #2 and #3 using the program, learned significantly more than the group receiving lectures only.

c. Student Evaluation

For three-fourths of the students in the two groups using the programed materials, this was their first experience with programed instruction. Their reaction was quite favorable. Sixteen indicated that the use of programed materials was a very positive learning experience, and they would like to use them again. Twenty-six expressed more positive than negative reaction to it. Only three expressed an unfavorable attitude.

The students were asked, "Without an instructor, would you prefer a program or a textbook?" Thirty-one preferred programed materials; only 10 preferred a textbook.

The students who used the programed materials were asked to compare this method of presentation of material with the lecture method. Twenty-three preferred the programed materials while 13 preferred lectures.

"Considering what you learned, was the program worth the time you spent?" Thirty-three said yes, only 5 said no. The students believed that the program gave them a sense of direction most of the time and the pace was about right most of the time.

The question, "Could you easily review the programed material?", did not bring favorable responses. Nine said "Yes", 16 said "No", while 23 were "Uncertain."

With the following two questions students were asked to characterize programed material as they experienced it. They could check more than one response. The three positive and three negative responses which were checked most often are presented below.

No.	Positive responses
39	In spite of its disadvantages, I learned much
23	It gave me a feeling of making progress
17	It made me think
	Negative responses
28	It was mechanical
25	It was boring
16	It was impersonal

The students were asked how they thought programed instruction should be used in college. Both groups which used programed materials (one exclusively, one in conjunction with lectures) felt the best way was as a supplement to textbooks and lectures. Thirty-one checked this response. The next highest total, 26, was "to bring students up to starting level in the course." Only 7 thought it should be used as a primary teaching device in place of lectures.

d. Instructor Evaluation

Professor Van Liere indicated that he had never used programed material before. Prior to this evaluation, however, he expressed an unfavorable attitude toward programed instruction.

His comments following the evaluation were, "I have a negative reaction to programed material, especially untested material, for college students. There are unwarranted assumptions as a basis for programed material: 1) That reinforcement techniques developed with infra humans apply directly to humans, 2) That the 'reinforcers' integrated in programed instruction are adequate for all college students."

He found no errors in the content of the program nor in the mechanics of presenting the material. He did not feel that the importance of the content justified the amount of time required of the student, and the program did not save the instructor time. Also, the program did not justify its cost.

Barbara Arnold participated with Professor Van Liere in the evaluation of the program and filled out an instructor questionnaire. She had not used programed materials before this time and her attitude toward programed instruction prior to the evaluation for GLCA was also unfavorable.

Her responses to the questions paralleled those of Professor Van Liere and she made these specific comments regarding the program. "This type of programed material which requires nothing more than token responses is very boring. In general, our students needed to be prodded a bit for the last week, or whole last half, of the program. Besides not retaining significantly more of this material than the lecture group, the book groups spent three or four times as long in acquisition, which hardly seems justified. The largest single problem involved is, I feel, maintaining students' interest and motivation."

In summary, the reaction of both evaluators to the use of programed materials in this course was more negative than positive.

10. Professor Robert O. Weiss, Department of Speech at DePauw University, evaluated two programs, Lehman's Parliamentary Procedure (Tutor text) and Gray and Rea's Parliamentary Procedure (Scott Foresman).

a. Method

He used approximately 18 students in each group. The groups were matched according to their sex, their verbal score on the SAT and by grade point average. Almost all of them were juniors or seniors in college.

Both groups were treated alike. In administering the program no control was kept over the amount each program was used. They were motivated by fairly frequent mention of the program in class. The students were informed that the test was constructed without specific reference to either program. The pressure of other work was likely to preclude the use of both programs by one student. The unit took four and one half weeks. All students were expected to be familiar with Robert's Rules of Order.

Instruments used were a pre test and a post test constructed by Weiss, the Student Evaluation Questionnaire and the Instructor Program Evaluation Questionnaire.

b. Results

The pre test and post test used in the evaluation each had 30 true-false questions and 15 multiple-choice covering parliamentary procedures. The true-false questions counted one point and the multiple choice questions, 2 points. The tests were scored on a right-minus-wrong basis. The students were told not to guess. The test results for the two groups are given below.

Group		Pre test	Post Test	Gain Score
A- Using Gray and Rea Program	Mean	-1.1	24.2	25.3
	N	16		
B- Using Lehman Program	Mean	-6.8	29.2	36.0
	N	18		

No further statistical analysis was done on the data but the mean scores for the two groups indicate that the students using the Lehman program learned more of the material that was included in the tests. No information is available on the amount of time students spent working on the programs.

c. Student Evaluation

Half of the students indicated this was their first experience with using programed materials. The overall response to the programs was favorable since 70% of the students indicated it was a very positive or more positive than negative learning experience. Also, a large majority, 82% of those responding, answered yes to the question, "Considering what you learned, was the program worth the time you spent?"

In response to the question, "As you see it now how should one use programed instruction in college?", the following interesting contrasts were observed. The students were allowed more than one response to this question.

No.	Response
24	As a supplement to textbooks and lectures
14	To teach material that the teacher does not want to cover
8	As a primary teaching device in place of textbooks
3	As a primary teaching device in place of lectures

The results indicate students see value in programed materials for supplementary purposes but not as a primary teaching device.

Twenty students indicated that the use of programed materials favorably affected their attitude toward the subject matter of the course. Only two responded unfavorably.

d. Instructor Evaluation

The instructor indicated he had used programed material before in the course named Public Discussion. He was using the present programs to teach material that he did not want to cover in class. He described it as follows, "It gives a more digestible approach to material contained in regular reading." His initial attitude toward programed material was favorable.

His specific reaction to it was as follows: The programs essentially covered the same material he wanted. He found minor errors in the content of the program and some technical errors in the program. The instructor was not certain that the importance of the content covered by the program justified the amount of time required by the student. He did not believe that the program saved the instructor time, but that it was justified in terms of its cost.

11. Professor Joseph Wetmore, Department of Education, Ohio Wesleyan University, conducted a study comparing two commercial programed texts in statistics. The first was Statistical Measures by Gorow and the second book was Basic Statistical Concepts by Bradley and McClelland.

a. Method

The study involved two classes of 40 students each. All the work on the program was done outside of class with no help from the instructor. The study lasted approximately one week. The same statistics achievement test was used for the pre and the post test. Gain scores were used to compare the achievement on the two programs. The amount of time the students spent working on the program was recorded.

b. Results

Group	N	Pre test Means	Post test Means	Gain Score Means
Program Gp #1 - Bradley and McClelland	34	11.3	24.1	12.8
Program Gp #2 Gorow	28	11.1	27.3	16.1

These preliminary results indicate that the students learned a considerable amount of material from both programs. The statistical analysis t (60) = 2.23 indicated the group using the Gorow text had a significantly higher mean gain scores (P = L.05). The possible score on both pre and post tests was 40 points.

c. Instructor Evaluation

Professor Wetmore had used programed texts before. He had used the text by Bradley and McClelland in the same course. He indicated that his attitude toward the programed instruction material was enthusiastic.

In reference to the book by Gorow, Wetmore said the following, "At the first glance I was not impressed with this book, it seemed rather skimpy, but it does provide good material. I like the fact that it is a branch rather than a linear text. The biggest problem is that students read this as a text-- page by page -- even when instructed not to. They do not let the book teach them, but attempt to memorize the material on each page. I feel that I probably would use this book next year!". As far as he could tell there were no errors in the book either of the technical or content kind. He felt that the importance of the content justified the amount of time required of the student. Also the program saved instructor time and it was justified in terms of cost. In summary, Professor Wetmore said that his overall reaction to programed material at this time was very positive and that he would like to use it again.

Referring now to the text by Bradley and McClelland, Wetmore had this to say, "I have used this same programed text before and had to supplement it with lectures. I would still have to clear up understandings since students do not know how to use this material even after being told." He found there were no errors either in content or technical errors of programing. Even with this program he felt that he preferred the programed material to the textbook and to the lecture but that he would have to supplement it.

d. Student Evaluation

This was the first experience with using programed material for 30 out of the 34 students using the Bradley and McClelland text. The overall reaction to this text was favorable for three-fourths of the students. The large majority of the students indicated that without an instructor they would prefer to use the program rather than a typical text, but regular lectures were preferred to the program.

The time spent on the program was justified in terms of what was learned in the opinion of two-thirds of the group. Students claimed it speeded up their learning and made them think. A large majority indicated the best way to use programed instruction was as a supplement to textbooks and lectures. Two-thirds of the group felt the use of programed materials favorably affected their attitude toward the subject matter while the rest of the group claimed it had no appreciable effect.

This is also the first experience with programed instruction for 24 of the 28 students using the Gorow text. Eighty-four percent of the group had a favorable reaction to its use. Without an instructor they preferred the program to a regular text. The group was evenly divided over whether they preferred lectures or the programed material.

Sixty-four percent of the students indicated the amount of learning justified the time spent on the program. In characterizing the program the group indicated it gave them the feeling of making progress. When asked how programed materials should be used on the college level, the leading responses were, as a supplement to textbooks and lectures, and for remedial work when a student falls behind. Sixty-percent of the students indicated the use of programed material had no appreciable effect on their attitude toward the subject matter.

12. Professor Dorothy Whitted, English Department of Ohio Wesleyan University, conducted a research project using the commercial program, Effective Writing by Smith and Stapleford.

a. Method

The study was designed to test the effectiveness of the programed materials versus tutorial help by the instructor in helping students overcome deficiencies in English composition. The students included in the study were those placed in the English proficiency program for remedial work on the recommendation of the English professor. The student remained in the program until a proficiency test was passed at which time the student returned to the regular program.

Pairs of students were matched for this evaluation study on the basis of their errors in composition on an essay they were required to write when they first entered the proficiency program. Approximately ten students were given the program materials and about ten were given tutorial help. When each student felt he had overcome his weaknesses, he was given another essay to write which was scored for errors on the same basis as the first essay. Achievement for the two treatments was based on gains in scores on the two assigned essays.

Professor Whitted used the same commercial program in another study involving two classes, each of twenty students, in a regular freshman English course. During this two week experiment one class used the programed materials exclusively while the control group class used the regular classroom instruction. A pre test and post test consisting of a required written essay was used to compare achievement in English composition under the two methods of instruction.

b. Results

Project 1. The score on the pre test and post test essays was a function of the number of sentences in the essay and the number of different kinds of errors that were made in the composition. The actual score was the ratio of number of sentences written per kind of error. For example, a score of 4.5 indicates that the student made an average of one kind of grammatical error in every 4.5 sentences that he wrote. The total number of errors in any essay was not computed since the main concern was the types of errors that were made. There was an average of two months between the pre and post test essays.

Group		Pre Test	Post test	Gain
Program	Mean	6.6	4.9	-1.7
	No. in Gp	7		
Tutorial	Mean	9.0	4.6	-4.4
	No. in Gp	7		

Each group wrote an average of approximately 20 sentences on both the pre test and the post test. Both groups did poorer on the post test essay in regard to the number of different types of errors that were made. The negative results do not allow any conclusions to be made on the relative value of tutorial versus programed instruction for remedial work in English composition.

Project 2: In this evaluation study two classes of freshmen participated for a period of two weeks. Essays were written for both the pre and post tests and the score was the number of sentences written per type of error made.

Group		Pre test	Post test	Gain
Program	Mean	6.4	10.4	4.0
	No. in Gp	21		
Control (regular instruction)	Mean	4.9	5.6	.7
	No. in Gp	14		

The two groups averaged between 15 and 20 sentences on both the pre and post test essays. The programed group showed considerable gain in eliminating different types of errors in their essays. The control group using regular instruction made only a slight gain. The results indicate that the program can make a significant contribution in eliminating types of grammatical errors in freshman English classes when used as a primary teaching method for a short unit of material.

c. Instructor Evaluation

Professor Whitted indicated that she had used programed material before. In evaluating the programed material she used, Professor Whitted said the following:

"Experiments in Writing by Smith and Stapleford is, as I have indicated, the best book of programed material dealing with the sentence that I have seen. However, it seems to me to have two major flaws.

1) Levels of difficulty

The book ranges from very simple to extremely complex sentence problems. Probably the authors intended to start with something very simple (agreement of subject and verb) to give the user of the book a feeling of confidence. With college students it seemed to give a false sense of the book's being a review of elementary material.

Chapters 2 and 5 are the two next easiest chapters, and they lend themselves to programing more than the others, although 3 and 4 can be explained more easily than 6 and 8, which are by far the hardest to get across through the medium of programing. It is chapters like these that prompt the comment of one boy, "You can't ask a book to explain something that you don't understand.'

2) Omission of important material

The most common and most critical error in sentence construction made by poor writers is the comma fault. Nowhere in the programed book is this structure discussed. By implication it is taken care of in the chapters dealing with subordination of sentence elements, but students needing to use the material at all are unable to make such remote connections. Consequently some very bad errors in the papers could not be pinpointed in the text, though they related to either subordination or coordination."

The instructor considered that the content covered by the program justified the amount of time required by the student. The program saved the instructor time but she was uncertain as to whether it was justified in terms of its cost. For her individual students and for her tutorial program, Professor Whitted indicated that she was more negative than positive toward programing. For the group experiment in project number two, however, she was more positive than negative.

Professor Whitted commented as follows:

"When I looked over the responses of the students who worked with the programed book, I was struck by the fact that the better writers tended to like the book and to think that they had gained good review from studying it; the poorer writers were the ones who complained about the frustrating order of the book and who seemed to be convinced that the whole book was a waste of time. These responses seem to bear out the point that the poorer writer is frustrated by having to work independently with material that is not orderly and that he does not always recognize his own weaknesses. As in the case of the remedial student, he often needs the support of a human being as well as the requirement for meeting frequent deadlines.

However, programed material seems to me to lend itself to use in a class of reasonably good freshmen students much more than of students who have problems in composing -- older students with more deepseated problems, those who are remedial cases. But I am sure also that certain kinds of people of any age respond to the programed material better than others."

13. Professor Francis Williams who teaches Organic Chemistry at Antioch College used Professor Theodor Benfey's program, Systematic Naming of Aliphatic Compounds.

a. Method

The program was used as a completely independent study. Williams did not lecture at all on the naming of these compounds during the course. The students were required to learn the nomenclature complete from the program.

The experimental group consisted of 28 students who took Williams' course in organic chemistry during the summer. The control group was a group that took the same course in chemistry in the fall.

For the experimental group, Williams gave out pre tests before the course began. He also handed out the total program consisting of six sections. He referred students to programs for all nomenclature and assigned nomenclature problems from the book, posting answers on the board. No help was given to the class on the nomenclature problems. After this procedure he gave the post test.

The control group consisting of 18 students was involved in the Fall quarter. They were given the pre-test, and unspecified number of lectures during the quarter and then the post-test.

b. Results

The experimental group had a mean gain score of 44.5; the control group had a mean gain score of 41.9. Although there was a significant amount of learning that took place in each group, no significant difference was found between the mean gain scores of the two groups. The programed materials taught as well as the traditional lecture method.

c. Student Evaluation

This was the first experience with programed material for 23 of the 28 students using the Benfey program. Eighty-two percent reacted favorably to the program. Without an instructor the students preferred the program to a typical text, but a majority preferred regular lectures to the program. An overwhelming ninty-two percent indicated that the time spent on the program was worth it considering how much they learned. They felt it speeded up their learning but tended to be quite mechanical.

The group felt that the best way to utilize programed material at the college level was as a supplement to textbooks and lectures. Seventy one percent felt that the program had no appreciable effect on their attitude toward the subject matter.

d. Instructor Evaluation

Williams had not used programed material before. He used the program as a primary teaching device in place of textbook and lectures. He described his attitude toward programed material as being favorably disposed to it. Regarding the results of the program he said the following: "I got excellent results on this material which requires rote systematic study. It also relieved me of the necessity of covering this in lectures. I don't like to lecture on it and it is not well received when I do."

"My subjective opinion is that the students did well, learning more than I would otherwise have required in no more study time. I saved lecture time."

In summary his overall reaction to the program he used was very positive and he would like to use similar material again. He said, "From material of this sort, rote learning of very systematic subject matter, it's the only way. I think we should attempt to push as far as possible into unsystematic subjects but be ready to stop wherever it fails."

14. Professor Robert Wilson, Mathematics Department of Ohio Wesleyan University, agreed to conduct a research project comparing two commercial programs covering elementary functions in mathematics. He used the following programs. TMI-Grolier Algebra Refresher; Wiley, Programed Beginning Algebra; TEMAC Analytic Trigonometry.

a. Method

The specific programs were used on two groups of 25 students each. The students selected for the study were those who had to meet a mathematics' proficiency requirement and did not wish to take a form of college-level mathematics course. The students were to be matched on a proficiency test in mathematics as well as a check on high school mathematic grades. All work was done in a room provided. Tutorial help was available and no post test was given. Evaluation was based upon the judgment of the tutors, student evaluation questionnaires and the instructor's program evaluation.

b. Student Evaluation

Nine students completed the attitude questionnaire and for two-thirds of these students, this was their first experience with programed materials.

All nine of the students indicated that it was a positive learning experience. Seven of the nine said they would prefer to learn the materials on their own by a program rather than by regular textbook.

Eight out of nine claimed that what they learned from the program justified the time spent on it.

When asked to indicate the best ways to use programed instruction in college, the three responses checked most often were as follows:

No.	Response
8	For remedial work when the student falls behind
6	To bring students up to starting level in the course
5	As a supplement to textbooks and lectures

When asked, "How has the use of programed material affected your attitude toward the subject matter of the course?", four responded favorably and five said it had no appreciable effect. No one responded negatively.

The summary of the responses on the student attitude questionnaires indicate a rather strong favorable reaction to programed instruction as used in the context of this study.

Professor Wilson substantiated this conclusion with the following statement. "The students who are participating in this program and who have taken the programed learning to develop those skills which they did not have on entering Ohio Wesleyan unanimously have very high praise for this program. Several have told me that even though they may be able to pass a competency examination before they have completed all of the programed material, they intend to come back and complete the material for they feel they are learning a great deal that they missed in their secondary mathematics."

c. Instructor Evaluation

The instructor indicated that he had not used programed material before. The programs used in this evaluation were used for remedial work when the student was falling behind (trigonometry); to bring students to a starting level of the course (algebra and trigonometry) and to teach material that the instructor did not want to cover in class (trigonometry).

His attitude before beginning the evaluation study was enthusiastic (for remedial emphasis). He said, "I was interested in it but not sure of the results."

Continuing to describe his reactions to evaluation of programed material Professor Wilson said, "The programs used were all good and accomplished the purposes for which they were adopted. The Wiley program in algebra appeared to be slightly better than the TMI Growlier program on the basis of the first results.

His specific reactions to programed material were as follows. He said that the program actually covered more than what would be covered in a remedial course. He found no errors in the content of the program nor did he observe any errors in the technical aspects of the program. He indicated that the importance of the material covered by the program justified the amount of time required by the students and that it saved his time as an instructor. The program also was justified in terms of its cost.

He knew of no better or similar programed materials and indicated that he preferred the programed material to both textbook and lectures for remedial work. In summary, his attitude toward using programed material the way he did was very positive.

DISCUSSION

A. Effectiveness of the Programs

The sample of commercial programs evaluated was in no way intended to be comprehensive or exhaustive. The programs were used under a variety of conditions believed to be beneficial to their students by the instructors involved. Nevertheless, some interesting observations can be made and used by interested faculty members to guide their selection and use of these programs.

First, in the natural sciences, two biology programs were tested. Kormondy found that his own commercially published program, Introduction to Genetics, produced better results than either comparable material in a regular textbook or presenting the material by lectures. Dillery was interested in determining if students would utilize programed material when it was made available to them. The biology program used in the study was Cells: Their Structure and Function. As might be expected, the poorer students did not read the program, even if it was assigned. The average and above students used the program more if the material was explicitly assigned rather than merely mentioned as a supplementary resource.

Two chemistry programs were tested. Reinheimer was quite pleased with Barrow's Programed Supplement for General Chemistry used as a review for unit examinations in Freshmen Chemistry. Williams evaluated Benfey's program, Systematic Naming of Aliphatic Compounds. His attitude toward the program was very positive, claiming that in his subjective opinion the students did well. "They learned more than I would otherwise have required in no more study time. And I saved lecture time."

In mathematics, Smyth evaluated the TEMAC program, Analytic

Trigonometry. The study lasted for an entire semester. The results indicate that students learned as much from the program as from lectures supplemented by discussions. However, both the instructor and the students expressed negative reactions to the program.

Wilson evaluated three mathematics programs for use with college freshmen. His subjective evaluation was that all three programs were beneficial for remedial work or to teach material not covered in class. He claimed that the students were enthusiastic about the programs also.

Wetmore compared two commercial programed texts in educational statistics. He believed that Gorow's text, Statistical Measures, was superior to Bradley and McClelland's Basic Statistical Concepts. However, the gain scores based on pre and post tests did not reveal significantly different group mean scores.

Hackstaff evaluated two programs in logic and found both to be unsatisfactory. He stated that the text, Class Logic, was in most ways superior to Basic Logic but neither was a good substitute for a general technical text in symbolic logic.

Whitted evaluated the program, Effective Writing, but Smith and Stapleford under two diverse conditions. As a remedial teaching device to overcome deficiencies in English composition, the program was unsatisfactory. However, with regular freshman English classes the program proved to be very helpful.

Weiss compared two commercial programs in speech. The results indicated that both Lehman's text, Parliamentary Procedure, and Gray and Rea's text, with the same title, resulted in significant learning by college students.

London and Van Liere both evaluated the well known text, Analysis of Behavior by Holland and Skinner. London found that it made no difference in achievement whether the students wrote answers in the blanks provided in the program or read the material in prose style with no overt response necessary. The group which was required only to read the material finished the program much faster, and consequently this method of presentation proved to be more efficient in terms of achievement than requiring students to fill in blanks.

Van Liere used the same text as a primary teaching instrument with one group and to supplement lectures with another group. Both these experimental groups scored significantly higher on an achievement test covering the material than a control group which heard lectures only. The students were positive in their attitude toward the program, but the instructor was quite negative in his reaction to the value of the programed material.

Finally, Charles and Rodriquez evaluated the TEMAC program, French Phonetics. Both instructors judged that the program alone was not adequate for teaching French pronunciation to beginners. Nevertheless, students did make some progress in pronunciation from using the program.

In summary, the evaluation of commercial programs did not change instructor attitudes toward programed instruction. Both favorable and unfavorable attitudes were retained. In two instances the instructors acknowledged the significant achievement made by their students using the programs, yet they remained negative toward programed instruction.

The results on achievement tests covering the material in the programs were too tentative to be used as a basis for judging the value of any particular commercial program. The Kormandy and London studies were the most carefully designed and executed. Therefore, in these two studies considerable weight can be given to the objective results which are reported. For this reason, these two studies are reported in much greater detail than the others.

B. Effectiveness of Evaluation Procedures

Each instructor was asked to judge the effectiveness of the procedures used to evaluate the program and then offer suggestions for improving the study. A large majority of the evaluators believed that the studies accomplished what they had hoped would be accomplished. Only minor changes were suggested to improve the studies.

data

One noticeable weakness in many of the studies was the tendency to gather much more data than could possibly be tabulated and analyzed. If evaluation studies of this nature are to be of value, the scope of each study must be clearly delineated and kept from becoming hopelessly broad or complex.

CONCLUSIONS

The evaluation of commercial programs provided first-hand experience to faculty members and students in the GLCA colleges with what was currently available on the market.

For a large majority of the students, this was their first experience with programed materials and the reaction in general was favorable. Reactions of faculty members who evaluated were mixed, about half favoring programed instruction and half disfavoring it.

No pattern was discernible in the teachers' reactions to the materials nor in the achievement of the students using them.

The studies provided the GLCA staff with an opportunity to try out a wide variety of program evaluation procedures. Although the results were indeterminate with respect to any overall conclusions about the value of programed materials at the college level, they were beneficial in providing guidelines to the designing of much better controlled studies of the GLCA-produced programs which were evaluated the following year, and the results of which are reported in the next chapter.

Chapter 6

EVALUATION OF GLCA-PRODUCED PROGRAMS*

INTRODUCTION

In Chapter 2 of the report the administration of the evaluation project was described. Chapter 4 reviewed related research. Chapter 5 reported the results of the evaluation of commercial programs and showed the need for more tightly controlled experimental designs. The experiment reported in this chapter was designed to gain evidence concerning three major questions: First, do programed materials teach? Secondly, do they teach as well as other methods of instruction? Thirdly, how can programed materials be most effectively used in college teaching?

Four specific questions were selected to serve as a focus for the evaluation of programed instruction at the college level. These questions were chosen because they seemed to be pertinent to the interests and concerns that GLCA faculty members had about programed instruction. The questions are: 1) Do programs teach as effectively as textbooks or lectures covering the same material? 2) What classroom activities such as question and answer discussions or lectures following the student's use of a program most effectively capitalize on what students have learned in the program? 3) Is the program more effective as an instrument for the acquisition of knowledge or as a device for reviewing information acquired earlier by some other means? 4) What effect do various motivational devices have on learning by programed materials versus other methods?

METHODS

Our concern was not only with learning as measured by tests but also in student attitude toward and instructor evaluation of the use of programed materials in comparison with other methods of instruction. Therefore, each student and instructor participating in the program was asked to express his opinions about various aspects of programing and other methods of instruction on an attitude questionnaire.

Description of the Sample

The twenty-four studies included in the experiment were conducted on the campuses of nine relatively small liberal arts colleges and universities located in the Middle West. Eight of these college and universities are members of the Great Lakes Colleges Association: Albion College, Denison University, DePauw University, Hope College, Earlham College, Kenyon College, Ohio Wesleyan University, The College of Wooster. Illinois Wesleyan University, Bloomington, Illinois also participated in the evaluation project.

---

* Dr. Donald Beane is the principal author of this chapter.

The following twenty six professors participated in the evaluation of the programs: Daniel Anderson, Brad Angell, Philosophy Department, Ohio Wesleyan University; Thomas Boyle, English Department, Albion College; T.R. Burkett, English Department, Denison University; Philip Church, English Department, Kenyon College; Robert DeHaan, Education Department, Hope College; Robert Johnson, English Department, DePauw University; William Judd, English Department, Ohio Wesleyan University; Mrs. Sue McNaghton, Department of Government, Denison University; Ray Mizer, English Department, DePauw University; Roy Morey, Department of Government, Denison University; Wendall Patton, Zoology Department, Ohio Wesleyan University; Morton Schagrin, Department of History of Sciences, Denison University; Lee Scott, Philosophy and Religion Department, Denison University; William Richard Stegner, Religion Department, Illinois Wesleyan University; William Stephenson, Biology Department, Earlham College; Jerry Stone, Religion Department, Illinois Wesleyan Univeristy; Jerome Tovo, Philosophy Department, College of Wooster; Philip Van Eyl, Psychology Department, Hope College; Melvin Vulgamore, Religion Department, Ohio Wesleyan University; Charles Weis, English Department, Ohio Wesleyan University; William Westbrook, Economics Department, Denison University; Louis Wilcox, Biology Department, Earlham College; Vannie Wilson, Biology Department, Denison University; Fred Wirt, Department of Government, Denison University; Frank Yow, Biology Department, Kenyon College.

A total of 1220 students from the nine colleges and universities participated in the project.

Programs to be Evaluated

The Great Lakes Colleges Association had authorized during the summer of 1964 the production of twenty-four programs by professors in the GLCA institutions. These were field tested in the Fall of 1964 and revised. In the Spring of 1965, five of the best programs were selected for the systematic evaluation described herein. These five programs were in English Poetry, Religion, and Logic, Biochemistry, and Political Science. The subject matter covered by the programs represents the three major divisions in the liberal arts curriculum: humanities, natural sciences and social sciences.

Detailed descriptions of and sample pages from the five programs that were selected for intensive evaluation are found in Chapter 3. The titles and authors are given below:

1. POETRY: METHOD AND MEANING,
   James W. Cook, Department of English
   Albion College, Albion, Michigan

2. LANGUAGE OF LOGIC,
   Morton Schagrin, Department of History of Sciences,
   Denison University, Granville, Ohio

3. BIOCHEMISTRY FOR BIOLOGISTS,
   William K. Stephenson, Department of Biology,
   Earlham College, Richmond, Indiana

4. STUDIES IN THE GOSPELS
   Robert Montgomery, Department of Religion,
   Ohio Wesleyan University, Delaware, Ohio

5. AN INTRODUCTION TO SYSTEMATIC ANALYSIS IN POLITICAL SCIENCE
   Lois M. Pelekoudas, Department of Political Science
   Antioch College, Yellow Springs, Ohio

Description of Evaluation Designs

Evaluation Design #1. The following design was used to answer the first question: Do programs teach as effectively as textbooks and/or lectures covering the same material? Below is a schematic diagram of the procedure for evaluating programs in comparison with other methods of instruction.

Table 1 - Summary of Evaluation Design #1

Group	Step 1	Step 2	Step 3	Step 4	Step 5
A	Pre-test Form A	Programed Material	Post-test Form A-1	Discussion[14] 1-3 periods	Final Test Form A
B	Pre-test Form A	Textbook Material	Post-test Form A-1	Discussion[14] 1-3 periods	Final test Form A
C	Pre-test Form A	Expository Lecture Material	Post-test Form A-1	Discussion[14] 1-3 periods	Final test Form A

---

[14] The term "Discussion" used throughout this chapter means a student originated question-and-answer session.

All groups were given the same test in Step 1, an alternate form of that test in Step 3 and the original test form again in Step 5. The students were asked to write 5 questions concerning the material covered in Step 2, and these questions formed the basis for the class discussions in Step 4. These class discussions were taped. The lectures were also taped to insure that the lectures covered the same material as that presented in the program and textbooks used in the experiment. In most of the studies under this design, two groups were compared rather than three.

Evaluation Design #2. The following design was used to answer the second question: What classroom activities, such as discussions or lectures, following the students' use of a program most effectively capitalize on what students have learned in the program? This design is basically an expansion of procedures used on Group A Design #1. Below is a schematic diagram of the basic design for evaluating programs in terms of the educational activities that follow their use:

Table 2 - Summary of Evaluation Design #2

Group	Step 1	Step 2	Step 3	Step 4	Step 5
A	Pre-test Form A	Programed Material	Post-test Form A-1	Discussion	Final Test Form A
B	Pre-test Form A	Programed Material	Post-test Form A-1	Review Lectures	Final Test Form A
C	Pre-test Form A	Programed Material	Post-test Form A-1	Combination of methods	Final Test Form A

The discussion for Group A was student-centered with the instructor taking no initiative to raise questions. In contrast to this, Group B received pre-structured lectures and any question and answer period following the lectures was structured by the professor.

Evaluation Design #3. The following design was used to answer the third question: Is the program more effective as an instrument for the acquisition of knowledge or as a device for reviewing information acquired by some other means? Below is a schematic diagram of the procedure for evaluating programs in terms of when they are used:

Table 3 - Summary of Design #3

Group	Step #1	Step #2	Step #3	Step #4
A	Pretest Form A	Programed Material	Supplementary Lectures	Post test Form A-1
B	Pretest Form A	Supplementary Lectures	Programed Material	Post test Form A-1

The same programed material was given to both groups. Also both groups received the same number of lectures with approximately the same content.

Evaluation Design #4. The following design was used to answer the fourth question: What effect on learning have various motivational devices such as volunteering vs non-volunteering and being graded vs. working for no credit?

In two studies a design similar to Design #1 was used but the students volunteered to participate in the experiment on their own time outside of class. They volunteered to work on a supplementary unit related to their course work but were not told in what manner the material would be presented. Then half were given the program and half received lectures over the same content.

Table 4 - Summary of Design #4

Group	Step #1	Step #2	Step #3
A	Pre test Form A	Programed Materials	Post test Form A^1
B	Pre test Form A	Lectures	Post test Form A^1

In the third study under Design #4 both volunteers and non-volunteers were used. Half of each group were told they would receive extra credit for the unit if the test scores on the unit would help their course grade. The second half were told the grade of this unit of work would count toward the final course grade regardless of how well or poorly they did. All students in this study used the programed materials exclusively.

Table 5 - Summary of Study #3,
Evaluation Design #4

	Extra Credit	Required Credit
Volunteer Group	1	2
Non Volunteer Group	3	4

Description of Tests used in the Evaluation Studies

The tests used to evaluate student learning were written by the authors of the programs with the exception of the political science tests, which were written by Fred Wirt, one of the evaluators of the program. The tests were 40-50 minutes in length with a format of questions 50 percent objective and 50 percent essay in nature. Two forms of each test, parallel in format and content, were written.

The preliminary forms of the tests were edited by subject matter specialists in the disciplines concerned and then revised prior to use in the evaluation studies. (A copy of one form of each test is included in Appendices E-1, E-2, E-3, E-4, E-5)

A summary of individual studies, programs, and designs appears on the next page in matrix form. The professor(s) conducting each of the twenty-four studies and the college or university where the evaluation study took place are also indicated on the chart.

Table 6 - Summary of 1964 GLCA Programs to be Evaluated

Program Topic	Poetry	Logic	Biochemistry	Religion	Political Science
Author College	Cook Albion	Schagrin Denison	Stephenson Earlham	Montgomery OWU	Pelakoudas Antioch
Design #1	Mizer and Johnson DePauw	Anderson OWU	Stephenson and Wilcox Earlham	Vulgamore OWU	Wirt Denison
	Church, Kenyon	Angell OWU		Stegner Ill. Wes. U.	
	Judd and Weis OWU	Van Eyl Hope	Yow Kenyon		
Design #2	Burkett Denison	DeHaan Hope	Stephenson and Wilcox Earlham	Scott Denison	McNaghten Denison
Design #3	Boyle Albion	Schagrin Denison	Patton OWU	Stegner and Stone Ill.Wes.U.	Morey Denison
Design #4		Tovo Wooster	Wilson Denison		Westbrook Denison

RESULTS

Summary of Composite Analysis of Learning

Table 7 summarises the analysis of learning. In all 24 studies the amount of learning by program and other methods was significent as measured by pre and post test scores ($p < .001$ in 23 of the studies).[15]

---

[15] The statement in the parentheses means that in 23 of the studies the obtained results, ie, the size of the increase in post test scores compared with pre test scores, would have occured by chance (p) less than once in a thousand cases.

In four of the studies under Design #1 the program was compared with text material. In one case the program surpassed the textbook, while in the other three studies, there were no significant differences in amount of learning between programed materials and text materials.

four

When the programed materials were compared with lectures, the programed materials resulted in significantly more learning in three studies. In four studies there was no difference in the amount of learning, and one case (Mizer-Johnson) the data were inconclusive.

Under Design #2 the four studies where valid comparisons could be made indicated no differences in learning due to the methods used following use of the program. This would lead one to conclude that he could follow the use of these programs by either discussion or lectures and obtain similar results.

In Design #3 the evidence indicates that students learn as well whether the program is used before or after the supplementary lectures.

In Design #4 students volunteering to study the material covered in the program did no better nor worse on the unit than those students who were required to learn the material as a regular part of the course.

The results of each study by program that was evaluated and design are presented on the following chart:

Table 7 - Summary of Results of Analysis of Variance by Program and Design

	Poetry	Logic	Biochemistry	Religion	Pol. Science
	Mizer-Johnson Lng*** P vs. L[1]	Anderson Lng *** P = T	Stephenson-Wilcox Lng *** P>L ** P>T **	Vulgamore Lng *** P>L *	Wirt Lng *** P = L
Design #1	Church Lng *** P = L	Angell Lng *** P = T	Yow Lng *** P>L ***	Stegner Lng *** P = L	
	Judd-Weis Lng ** P = L	Van Eyl Lng *** P = T			
Design #2	Burkett Lng *** P + D=P+L	DeHaan Lng *** P + D=P+L	Stephenson-Wilcox Lng *** P + D = P+L =P+D (Mixed)	Scott Lng *** P + D vs P+ L[1]	McNaghten Lng *** P+D = P+L
Design #3	Boyle Lng *** P+L=L+P	Schagrin Lng *** P+L=L+P	Patton Lng *** P + L=L+P	Stegner-Stone Lng *** P + L=L+P	Morey Lng *** P+L=L + P
Design #4		Tovo Lng *** P = L	Wilson Lng *** P = L		Westbrook Lng *** V = NV

as

De Haan
ok over →

Lng - Learning asmeasured by differences between pre and post test scores
P - Programed materials
L - Lectures
T - Text materials
D - Discussion
V - Volunteers
NV - Nonvolunteers
= - No statistically significant differences
* - P<.05 P, refers to the probability of the obtained results
** - P<.01 having occured bychance. <.05 means that the
*** - 0<.001 is less than 5 in 100; <.01 probability less than 1 in 100; <.001 - less than 1 in 1000.

Eg., P>L means that program was superior to lecture.

← refe
to
? H

by

---

[1] data not conclusive since groups not comparable due to significant differences in means of pre-test scores.

OK

Attitudes toward Programed Instruction

Student Attitudes: Summary of All Studies Combined. One of our major areas of evaluation concerned student attitudes toward programed instruction. Did the students think that learning by programed instruction was a positive learning experience, regardless of whether tests indicated they learned or not?

We investigated student attitude toward methods of instruction from four separate points of view.

1. General impression of the learning experience.
2. The pace or rate at which the information was presented.
3. The sense of direction which the method of instruction conveyed.
4. The ease or difficulty with which the material presented could be reviewed.

For the exact wording of the questions and the five responses to each, refer to Questions 4, 5, 6, and 7 of the Teaching-Method Evaluation Questionnaire in Appendix E-6.

Scoring the responses from 1 to 5, we calculated mean ranks for each method of instruction used in the evaluation. The mean ranks and number of students responding to each question are presented in Table 1, Appendix E-7.

Examination of this table reveals that students thought all four methods of instruction provided a more positive than negative learning experience, the pace was about right, and the students had a sense of direction most of the time. In general, the students felt that review was fairly easy for programed materials, textbooks and lectures, while review of material presented in class discussions was fairly difficult.

A statistical analysis compared attitudes toward programed materials with those toward other methods of instruction. The two-tailed t-ratio * was used based on correlated observations to test the null hypothesis of no differences. The tests revealed that students had a significantly more favorable attitude toward programed materials than discussion as a positive learning experience, $t(505) = 5.47$, $p < .001$. Students felt the pace of programed

---

* The two tailed t-ratio is used when the investigator is not interested in which group is superior, only if there is a significant difference in the means of the two groups. See Appendix E-9 for the formulas used in computing the t-ratios.

OK

materials was better than learning by class discussion t (477) = 3.80, $p < .001$ and the sense of direction was significantly better t(486) = 4.70, $p < .001$. Review of programed materials was also judged to be significantly easier than review of class discussions, t (443) = 12.46, $p < .001$.

The only significant differences between programed instruction and lectures was in the sense of direction. Students believed that lectures did a better job in this regard than the programed materials, t (325) = 2.90, $p < .001$.

Professor Attitudes: Summary of All Studies Combined. The college professors who conducted the program evaluation studies filled out an attitude questionnaire similar to the student questionnaire. The questionnaire was completed at the end of each experiment. A copy of the questionnaire is included in Appendix B.

We were interested particularly in whether participation in a programed material evaluation study would change any professor's attitude toward programed instruction. Questions #7 and #31 were designed to provide an indication of change in attitudes. A summary of the number of professors choosing each response to these two questions are presented below.

Q#7 Describe your attitude toward programed instruction prior to evaluation of the material for GLCA.

4	Enthusiastic
12	Favorably disposed
10	Uncertain
2	Unfavorably disposed
0	Strongly disagree

Q#31 In summary, what is your overall reaction at this time to using programed material in this course?

14	Very positive, would like to use similar material again
15	More positive than negative reaction to it
0	Indifferent to using it
0	More negative than positive reaction to it
0	Very poor, would object to using it again.

OK

The change to a more favorable attitude toward programed materials was very striking after personal experience with a good program.

In evaluating the pace of the program, the professors responded as follows:

3	too fast
1	Too slow
6	Uneven
18	About right

The pattern of responses closely paralleled those of the students, who also felt the pace of the programed materials was about right.

Question #18 concerned the sense of direction which the program provided. The professors responded as follows:

Does the student get a sense of direction where he is going from the program?

19	yes
3	no
5	at times

One criticism which is frequently made about programed materials is that they are of little use for review purposes. Question #19 asked for professor attitudes in this area. The responses are given below:

Can the student easily review the programed material?

21	yes
4	no
1	at times

The following three questions call for evaluation of the program as a practical instrument for learning.

Question #13. In your opinion does the program actually teach what it claims to teach to the students for whom it is presumably designed?

OK

24 yes

0 no

4 partly

Question #21. Does the importance and amount of content covered justify the amount of time required of the student?

20 yes

1 no

7 uncertain

Question #22. Does the program save the instructor time?

23 yes

3 no

2 uncertain

In conclusion, the professors believed the programed materials taught the students something worthwhile in a reasonable amount of time with the added bonus that the professor saved valuable time.

Analysis of Students' Attitudes Toward Specific Programs

Poetry Program. The mean ranks of all students participating in one of the studies evaluating the poetry program are given in Table 2, Appendix E-7. The difficulty of reviewing material covered in class discussion is the only deviation from the general pattern of responses to all four methods of instruction. The mean rank of 2.53 for review by discussion indicates that students perceive discussion as being more difficult to review.

The analysis by t-test comparing programed instruction with lecture and programed instruction with discussion revealed the following significant differences in mean ranks.

Students viewed lectures as a more positive learning experience than programed material. $\underline{t}(74) = 2.48$, $p < .05$.

Review was easier by programed materials than by discussion, $\underline{t}(80) = 5.16$, $p < .001$.

Logic Program. The students expressed similar attitudes toward all four methods of instruction in regard to the logic program. The one exception was again in the area of review where class discussion was judged by students to be the most difficult to review. (See Table 3 Appendix E-7.)

The analysis by t-test revealed the students felt that the program materials were significantly better than class discussion as a worthwhile learning experience $t(88) = 2.54$, $p < .05$; in sense of direction, $t(74) = 2.01$, $p < .05$; and in ease of review, $t(62) = 2.37$, $p < .05$.

In comparing the programed materials with lectures, the students preferred the programed materials as a positive learning experience, $t(62) = 2.94$, $p < .01$. However, the pace of the programed materials was too slow compared to the lectures $t(64) = 3.14$, $p < .01$.

Biochemistry Program. The mean ranks of student responses (see Table 4 Appendix E-7) indicate they considered the programed materials to be more positive than negative as a learning experience and that the pace was about right most of the time. The program provided a sense of direction to the student and he found it easy to review.

In comparing the program with lecture and with class discussion, the following results emerge. The students preferred the programed materials over discussion in three areas evaluated in this study.

a.	positive learning experience	$t(175) = 9.58$, $p < .001$
b.	sense of direction	$t(172) = 4.37$, $p < .001$
c.	ease of review	$t(153) = 6.67$, $p < .001$

The lecture was preferred to the program in giving a better sense of direction. $t(51) = 2.51$, $p < .05$.

Religion Program. Refer to Table 5 in Appendix E-7 for a summary of mean ranks for all students participating in one of the studies involving the religion program. Discussion was found to be more difficult to review than other methods of instruction.

Analysis of student responses on the questionnaire revealed that students believed the program provided a better sense of direction than class discussion,$(101) = 2.99$, $p < .01$ and was easier to review, $t(94) = 9.11$, $p < .001$.

In the opinion of the students, the lectures were paced better than the program they used, $t(83) = 3.07$, $p < .01$, while the program was easier to review than lectures $t(83) = 2.15$, $p < .05$.

OK

Political Science Program. Refer to Table 6 in Appendix E-7 for a summary of student attitudes in regard to the material covered in the political science program. Students felt that discussion was more difficult to review than other methods of instruction.

Analysis of the data revealed a significant difference in mean rank of student responses to programed materials and discussion as a method of instruction. The students preferred the program to discussion as a positive learning activity $\underline{t}(53) = 2.03$, $p < .05$ and believed the program was easier to review $\underline{t}(50) = 4.36$, $p < .001$.

No significant differences in mean ranks occurred when comparing this particular program with lectures covering the same material.

Description and Analysis of Results of the Individual Studies

STUDY 1

Evaluators: Ray Mizer and Robert Johnson, English Dept., De Pauw University.

Program: Poetry: Method and Meaning by James Cook.

Course in which program was tested: Two sections of Introductory Poetry.

Dates of Experiment: September 13 - 27, 1965.

Design: Number 1. Group A was given the programed material, Group C received expository lectures. There was no Group B.

Details of Evaluation Design: Professor Mizer was in charge of the programed material group and Professor Johnson delivered the expository lectures to Group C. These were two separate classes. The students worked on the program completely on their own time outside of class. The class discussions were taped and the lectures were taped. The evaluators constructed a content test, 50 minutes, half objective and half essay over the material covered in class discussion during the second week. Each student was asked to write five questions about their reaction to the material covered in the program and the lectures.

Results: The method of presentation was confounded with the professor variable. Further, a preliminary analysis of pretest scores indicates that statistically, the two groups were drawn from different populations. Therefore, valid comparison of methods by analysis of variance* cannot be made in this particular case.

---

* For statistical procedures used in the analysis of variance See Appendix E-10.

OK

However, the differences between the pre and post test scores indicate that both groups learned from the method of presentation used, either programed materials or lectures. See Tables 1 a,b and c in Appendix E8 for summary of data.

The attitudes of the students were analyzed and the only significant differences in mean rank was in regard to review, where the program was judged to be easier than class discussion, t*(23) = 2.10, $p < .05$.

STUDY 2

Evaluator: Philip Church, English Dept., Kenyon College.

Program: Poetry: Method and Meaning by James Cook.

Course in which program was tested: Two sections of Freshman English.

Dates of Experiment: November 16 - December 16, 1965.

Design: Number 1. Group A received the program while Group C received lectures over the same material. There was no Group B.

Details of Evaluation Design: The two classes participating in the study were divided in half with one-half receiving the program and the other half the lectures. The discussions in class were taped as well as the lectures.

Results: The amount of learning for both the program and lecture groups was significant, $p < .001$. Students learned as well by the method of program as by lecture method. No interaction[16] was evident. Summaries of group means and the analysis of variance are presented in Tables 2a and b in Appendix E-8.

The analysis of student attitudes in this study indicated no significant differences in mean rank in groups comparing programed instruction with other methods of instruction.

STUDY 3

Evaluators: William Judd and Charles Weis, English Dept., Ohio Wesleyan University.

Program: Poetry: Method and Meaning by James Cook.

---

* t based on correlated observations

[16] No interaction indicates that the groups did not learn at significantly different rates.

OK

Course in which program was tested: Elective Course in Poetry.

Dates of Experiment: September 22 - October 13, 1965.

Design: Number 1. One group was given the program, the other group received lectures over the same material.

Details of Evaluation Design: The instructor in each section asked for volunteers to work through a short supplementary unit on poetry outside of class. The groups were very small with few volunteers so the volunteers and non-volunteers were combined in each class. Professor Weis was in charge of the program group and Professor Judd in charge of delivering the lectures to the other group. The lectures and class discussions were taped. The two evaluators collaborated in constructing a 40 minute content test, half essay and half objective which was given to both classes, in addition to the pre and post tests used in the evaluation.

Results: The amount of learning during the study for both the program and lecture groups was significant, $p < .001$. The students learned as well by program as by lecture. No interaction was evident. See Table 3a and b Appendix E-8 for data summaries.

The analysis of student attitudes in this study revealed no significant differences in mean rank between programed instruction and other methods of instruction.

STUDY 4

Evaluator: T. R. Burkett, English Dept., Denison University.

Program: Poetry: Method and Meaning by James Cook.

Course in which program was tested: Two sections of Freshman English.

Inclusive dates of experiment: January 3 - 19, 1966.

Design: Number 2. Group A, program followed by discussion; Group B, the program followed by lecture and instructor-directed question-and-answer period.

Details of Evaluation Design: The discussions were taped, the evaluator constructed a 50 minute test over the content covered in the three periods devoted to it. Test was half essay and half objective.

Results: The amount of learning during the study for both

OK

the program discussion and program-lecture groups was significant $p < .001$. No significant differences in learning were found in the methods of instruction used; there was no significant increase in learning after lecture or discussion. The analysis of variance revealed no significant interaction. See Tables 4a and b Appendix E8 for details.

In analyzing student attitudes toward different methods of instruction it was found that students preferred the programed materials to discussion for review purposes, $t^*(32) = 4.17$, $p < .001$.

STUDY 5

Evaluator: Thomas Boyle, English Dept., Albion College.

Program: Poetry: Method and Meaning by James Cook.

Course in which program was tested: Two sections of American Literature.

Dates of Experiment: November 22 - December 16, 1965.

Design: Number 3. Group A, program followed by lecture; Group B, lecture followed by program.

Details of Evaluation Design: Two content tests were written by the evaluator each 50 min., half essay and half objective. These were administered in addition to the pre and post tests given to all participants. The discussions and lectures were taped.

Results: The amount of learning was significant for both groups $p < .001$. The students learned as much whether the program was used before or after supplementary lectures. The analysis of variance revealed no significant interaction. See Tables 5a and b Appendix E-8 for details.

The analysis of student responses on the attitude questionnaire revealed two comparisons of teaching methods which were statistically significant. The lectures were preferred to the program on the question asking students to rate each method of instruction as a positive learning experience, t^* (52) - 2.09, $p < .05$. The students also expressed a preference for the lectures over the program in regard to the sense of direction that each method conveyed, t^* (51) = 2.05, $p < .05$.

STUDY 6

Evaluator: Daniel Anderson, Philosophy Dept., Ohio Wesleyan University.

---

* t based on correlated observations.

OK

Program: Language of Logic by Morton Schragrin.

Course in which program was tested: Two sections of Introduction to Philosophy.

Dates of Experiment: first half - Sept. 20 - Oct. 8, 1965; second half - Jan. 4, - 18, 1966.

Design: Number 1. Group A was given the program; Group B was given text material covering the same content.

Details of Evaluation Design: One section was used for the experiment during the fall term. It was split in half with the first half receiving the program and the second, the text material. The same was done with the one section using the experiment during the winter term. The two program groups and the two textbooks groups were then combined; students were assigned to the groups on a random basis. The textbook version was written specifically for this project following the content of the program that was being evaluated. The class discussions and lectures were taped.

Results: The amount of learning was significant for both the group using programed materials and the group using regular text materials, $p < .001$. The students using the program learned as much as the students using the text materials; and the analysis of variance revealed no interaction. See tables 6a and b Appendix E-8 for details.

The analysis of student attitudes revealed that students preferred programed materials to discussion for review purposes $t^{*}(11) = 3.05$, $p < .01$.

STUDY 7

Evaluator: Brad Angell, Philosophy Dept. Ohio Wesleyan University.

Program: Language of Logic by Morton Schagrin.

Course in which program was tested: Two sections of Introduction to Philosophy, one in the fall quarter and one during the winter quarter.

Dates of Experiment: First half, October 16-28, 1965; the second half, January 21-February 11, 1966.

Design: Number 1. Group A, program material; Group B, textbook material.

---

* t based on correlated observations.

OK

Details of Evaluation Design: Half the students in the fall section were given the programed unit and half the text material. The same was done with the other section. The groups were split randomly. The textbook material used in the study was taken from Professor Angell's own text on Logic. The class discussions for both groups were taped.

Results: The amount of learning was significant for both the program and the textbooks groups, $p < .001$. No significant differences in amount of learning favored one method over the other. Students learned equally well from both program and text materials. Also the analysis of variance revealed no significant interaction. See Tables 7a and b Appendix E-8 for summaries of the data.

The analysis of student attitudes revealed a preference for the programed material over class question and answer discussion in the areas of positive learning experience $t^*(9) = 4.98$, $p < .001$; sense of direction $t^*(8) = 2.64$, $p < .05$; and ease of review, $t^*(6) = 4.25$, $p < .001$. The students expressed opinions favoring programed instruction over the textbook as a positive learning experience, $t^{**}(42) = 2.55$, $p < .01$.

STUDY 8

Evaluator: Philip Van Eyl, Psychology Dept., Hope College.

Program: Language of Logic by Morton Schagrin.

Course in which program was tested: Introduction to Psychology.

Dates of Experiment: September 27 - October 8, 1965.

Design: Number 1. Group A, programed materials and Group B, text materials.

Details of Evaluation Design: The text material used was specifically written for this experiment and based upon the content of the program being evaluated. Each of the two sections were split randomly into groups A and B. The students worked independently on the program outside of class. The class discussions were taped.

Results: The amount of learning was significant for both the

---

[*] t based on correlated observations

[**] t based on independent samples.

OK

program and textbook groups, $p < .001$. The students learned equally well by program or textbook since no significant differences in method were found, but the analysis of variance indicated a significant interaction, $p < .05$. The interaction reveals that the rate of learning under the method of programed instruction was faster than the textbook method. See Tables 8a and b Appendix E-8 for details.

The analysis of student attitudes revealed the program was preferred to classroom discussion as a positive learning experience $\underline{t}^{*}(24) = 3.46$, $p < .001$ and for review purposes $\underline{t}^{*}(11) = 3.64$, $p < .001$. The program was also preferred to the textbook material as a positive learning experience, $\underline{t}^{**}(60) = 3.00$, $p < .001$.

STUDY 9

Evaluator: Robert De Haan, Education Dept., Hope College.

Program: Language of Logic by Morton Schagrin.

Course in which program was tested: Educational Psychology.

Dates of experiment: October 5 - 19, 1965.

Design: Number 2. Group A, program then review lecture; Group B, program then discussion.

Details of Evaluation Design: Students worked on the program on their own time outside of class. Professor Schagrin, writer of the program, conducted the discussion session and also delivered the review lecture. The lecture and discussion were taped.

Results: The amount of learning for both the program + discussion group and the program + lecture group was significant, $p < .001$. No significant differences in learning due to method were found. The data reveal that the lecture group learned more from the program than did the discussion group but the latter caught up as a result of what was learned during the discussion. The net result was that both groups learned the same amount of material during the experiment. The analysis of variance revealed no significant interaction. See Tables 9a and b Appendix E-8 for details.

The analysis of student attitudes revealed the program was believed to be a more positive learning experience than listening

---

* t based on correlated observations

** t based on independent samples.

OK

to the lectures, $t^*(27) = 3.59$, $p < .001$. However, the lectures were considered to be better paced than the program $t^*(27) = 3.98$, $p < .001$ and had sense of direction in the opinion of the students, $t^*(28) = 2.53$, $p < .01$.

STUDY 10

Evaluator: Morton Schagrin, Dept. of History of Sciences, Denison University.

Program: Language of Logic by Morton Schagrin.

Course in which program was tested: One section of Introductory Philosophy.

Dates of Experiment: Sept. 17 - October 4, 1965.

Design: Number 3. Group A, program followed by supplementary lectures; Group B, lectures followed by the program.

Details of Evaluation Design: Half of the class was given the program first while the other half received the lectures first, then the methods of instruction were reversed. The groups were determined randomly. The students worked on a program outside of class. The supplementary lectures were taped.

Results: The amount of learning for both groups was significant, $p < .001$. The amount of learning was the same whether the program was used before or after the supplementary lectures. The analysis of variance revealed no interaction.

The analysis of student attitudes revealed no significant differences between the method of instruction used in the study. See Tables 10a and b, Appendix E-8 for summaries of results.

STUDY 11

Evaluator: Jerome Tovo, Philosophy Dept., College of Wooster.

Program: Language of Logic by Morton Schagrin.

Course in which program was tested: Introduction to Philosophy

Dates of Experiment: Sept. 25 - Oct. 2, 1965.

---

* based on correlated observations.

OK

Design: Number 4. Group A, program; Group B, lectures. Volunteers only were used in this experiment.

Details of Evaluation design: Half of the volunteers had the programed materials and half attended lectures covering the same material. The students were asked to volunteer for a supplementary unit on Symbolic Logic without being told which method of instruction would be used. They were asked to participate in this experiment outside of regular class time. The lectures were taped.

Results: The amount of learning for both the program and the lecture groups was significant, $p < .001$. No differences in learning owing to method appeared. Students learned as well by program as other methods. There was no interaction. See Table 11a and b Appendix E-8 for summaries of data.

The analysis of student attitude questionnaires revealed that students considered the lectures paced better than the program, $\underline{t}^{**}$ (4b) = 2.05, $p < .05$. Also the lectures were preferred to the program for review purposes $\underline{t}^{**}(46) = 2.12$, $p < .05$.

STUDY 12

Evaluators: William Stephenson and Louis Wilcox, Biology Dept. Earlham College.

Program: Bio-Chemistry for Biologists by William Stephenson.

Course in which program was tested: General Biology.

Dates of Experiment: October 1 - November 5, 1965.

Design: Number 1: Group A, program; Group B, text material; Group C lectures.

Details of Evaluation Design: The evaluators consulted numerous texts and consolidated a list of material for the students to use as required reading in the text material group. Students in the program material group were on their own outside of class. The discussions and lectures were taped.

Results: Three groups were involved in this study: 1) program 2) text and 3) lecture. The amount of learning in all three groups was significant, $p < .001$. The program group was significantly better in learning than either text or lecture, $p < .01$. The

---

** t based on independent samples.

analysis of variance revealed significant interaction, $p < .001$, indicating the program resulted in learning at a faster rate than either the text or lectures. See Table 12a and b Appendix E-8. Neither the text material nor the lectures could cover all the material in the program. Consequently, to provide a better basis of comparison, adjusted scores were obtained based upon only the material covered by each method of instruction. The program still resulted in significantly greater learning than either other group.

The analysis of student attitudes revealed significant difference in mean ranks of student responses to different methods of instruction. As a positive learning experience the students preferred the program both to the textbook method $\underline{t}^{**}(58) = 4.49$, $p < .001$ and discussion $t^{*}(28) = 2.18$, $p < .05$. Also the lectures were preferred to the textbook materials $\underline{t}^{**}(62) = 2.21$, $p < .05$. In regard to the pace of the material students believed the program went too fast in comparison with class discussions $\underline{t}^{*}(29) = 4.10$, $p < .001$. They preferred the pace of the lectures to textbook material $\underline{t}^{**}(60) = 2.34$, $p < .05$. However, for review purposes, the program was preferred to both class discussion $\underline{t}^{*}(24) = 2.23$, $p < .05$ and the text materials $\underline{t}^{**}(59) = 2.05$, $P < .05$. In regard to having a sense of direction, the students preferred the program to the text material $\underline{t}^{**}(58) = 4.68$, $p < .001$ and lecture over text material $\underline{t}^{**}(61) = 3.27$, $p < .01$.

STUDY 13

Evaluator: Frank Yow, Biology Dept., Kenyon College.

Program: Bio-Chemistry for Biologists by William Stephenson.

Course in which program was tested: One section of Introductory Zoology.

Dates of Experiment: Sept. 20 - Oct. 25, 1965.

Design: Number 1. Group A received the program, the second group received a combination of lectures and textbook material as required reading.

Details of Evaluation Design: The group using the program worked on their own outside of class. The lectures and discussions were taped.

Results: Both the program and the lectures resulted in a significant amount of learning, $P < .001$. However, the program was

---

[*] t based on correlated observations

[**] t based on independent samples.

superior to the lectures in this regard, $P < .001$. The analysis of variance revealed significant interaction, $P < .001$, with the program group learning at a significantly faster rate than the lecture group. See Tables 13a and b Appendix E-8 for details.

The analysis of student attitudes revealed no significant differences in mean rank among the methods of instruction compared.

STUDY 14

Evaluators: William Stephenson and Louis Wilcox, Biology Dept. Earlham College

Program: Bio-Chemistry for Biologists by William Stephenson

Course in which program was tested: General Biology

Dates of Experiment: Oct. 1 - Nov. 5, 1965

Design: Number 2. Group A, program followed by a discussion; Group B, program followed by review lectures; Group C, program intermixed with class discussion at the end of each week of the experiment.

Details of the Evaluation Design: Group A had no chance to discuss the material in the class until the program was completed; however, all three groups were required to hand in answers to review questions at the end of each unit of the program. The lectures and class discussions were taped.

Results: Three groups participated in this study to compare different methods of instruction following the use of a program. The three groups were 1) program + discussion, 2) program + review lecture, 3) program + weekly class discussion (mixed group). All methods resulted in a significant amount of learning, $p < .001$. There was no significant difference in the amount of learning using different methods of instruction as measured by the three tests. Also the analysis of variance revealed no significant interaction. See Tables 14a and b Appendix E-8 for details.

In alalyzing student responses to the attitude questionnaire, the only significant differences were in comparing the program to discussion. The program was preferred to discussion as a positive learning experience $\underline{t}^*(67) = 6.07$, $p < .001$; in the sense of direction it conveyed $\underline{t}^*(65) = 4.00$, $p < .001$ and for review purposes, $\underline{t}^*(55) = 5.73$, $p < .001$.

---

* t based on correlated observations.

STUDY 15

Evaluator: Wendell Patton, Zoology Dept., Ohio Wesleyan University.

Program: Bio-Chemistry for Biologists by William Stephenson.

Course in which program was tested: Zoology.

Dates of Experiment: Sept. 17 - Oct. 2, 1965.

Design: Number 3. Group A, program then supplementary lectures; Group B, lectures then program.

Details of Evaluation Design: One lab section was designated as group A and the other as Group B. Students worked on the program in lab and on their own for 1 1/2 weeks. Approximately the same lectures were given to both groups. These were taped and the discussions in class were taped.

Results: This study indicated a significant amount of learning took place whether the program was used before or after supplementary lectures, $p < .001$. No significant differences in amount of learning or rate of learning was found between the two groups. See Table 15a and b Appendix E-8 for details.

The analysis of student responses to the attitude questionnaire revealed significant differences in mean ranks in three areas. As a positive learning experience, the program was preferred to discussion $t^*(51) = 9.68$, $p < .001$. The question on sense of direction revealed a preference for the lectures over the program $t^*(49) - 2.73$, $p < .01$ and program over the class discussions $t(49) = 3.27$, $p < .01$. For review purposes the program was preferred to the lectures $t^*(47) = 3.48$, $p < .01$.

STUDY 16

Evaluator: Vannie Wilson, Biology Dept. Denison University.

Program: Bio-Chemistry for Biologists by William Stephenson.

Course in which program was tested: Freshman Biology.

Dates of Experiment: Oct. 18- Nov. 17, 1965.

Design: Number 4. Group A, program; Group C, lectures

---

*t based on correlated observations.

Details of Evaluation Design: Students in both sections were asked to volunteer for a supplementary unit of work in bio-chemistry. Practically all the students in the two sections volunteered; consequently, there was no subdivision among volunteers and non-volunteers. Thus, this study is included under Design Number 4. The students worked independently on the program outside of class. The lectures and class discussions were taped.

Results: Both the lecture method and the program method resulted in a significant amount of learning, $p < .001$. And there was as much learning by program as by lecture. However, the analysis of variance showed the program group learned at a faster rate i.e. there was significant interaction, $P < .001$. See Tables 16a and b Appendix E-8 for details.

The analysis of student responses to the attitude questionnaire revealed only two areas of significant differences in mean ranks. The lecture method was preferred to the program method as a positive learning experience $\underline{t}^{**}(87) = 2.99$, $p < .01$. However, the pace of the program was preferred to the pace on the class room discussions $\underline{t}^{*}(25) = 2.34$, $p < .05$.

STUDY 17

Evaluator: Melvin Vulgamore, Religion Dept., Ohio Wesleyan University.

Program: Studies in the Gospels by Robert Montgomery.

Course in which program was tested: One section of Bible.

Dates of Experiment: Nov. 1 - 15, 1965.

Design: Number 1. Group A, program; Group C, lectures.

Details of Evaluation Design: Both the class discussions and the lectures were taped. The class was divided randomly into the two groups, the group using the program worked on their own outside of class.

Results: The amount of learning was significant for both the programed and lecture groups, $p < .001$. The program method resulted in significantly more learning than the lecture method, $p < .05$. The analysis of variance revealed that the interaction was significant, that is, the rate of learning in the program group was significantly faster than in the lecture group, $p < .05$. See Table 17a and b Appendix E-8 for details.

---

*t based on correlated observations

**t based on independent samples

The analysis of student responses to the attitude questionnaire revealed that the students preferred the lectures to the program as a positive learning experience $\underline{t}^{**}(37) = 3.99$, $p < .001$. In the area of pacing of the material presented, the students preferred the program to the lectures indicating that the lectures were too fast $\underline{t}^{**}(37) = 3.48$, $P < .01$. For review purposes the students preferred the program to class discussion $\underline{t}(14) = 7.62$, $p < .001$.

STUDY 18

Evaluator: Richard Stegner, Religion Dept., Illinois Wesleyan University.

Program: Studies in the Gospels by Robert Montgomery.

Course in which program was tested: Two sections of Religion I, Introduction to Christianity.

Dates of Experiment: Oct. 4 - 20, 1965.

Design: Number 1. Group A, program; Group C, lectures.

Details of Evaluation Design: Half of each section was designated as the program group and half received the lectures. The selection was done randomly. The students worked on the program outside of class on their own time. The class discussions and lectures were taped.

Results: The amount of learning was significant for both the program and lecture groups in this study, $p < .001$. Students learned as well by program as by lecture method. The analysis of variance revealed no significant interaction. See Tables 18a and b Appendix E-8 for details.

The analysis of student responses on the attitude questionnaire revealed the following significant differences in mean ranks. As a positive learning experience the program was preferred to class discussion $\underline{t}^{*}(6) = 3.04$, $p < .05$. No other significant differences in student attitudes appeared.

STUDY 19

Evaluator: Lee Scott, Philosophy and Religion Dept., Denison University.

---

*t based on correlated observations

**t based on independent samples.

Program: Studies in the Gospels by Robert Montgomery.

Course in which program was tested: Introduction to Philosophy and Religion, two sections.

Dates of Experiment: Jan. 3 - 21, 1966.

Design: Number 2. Group A, program then class discussion; Group B, program then lecture and instructor-directed question and answer period.

Details of Evaluation Design: One section was designated as group A and received the programed instruction, the other section received the lectures. Students worked independently on the program outside of class. Discussions, question and answer sessions, and lectures were all taped.

Results: A preliminary analysis of sample means revealed that the samples were not drawn from the same statistical population; consequently the significant differences between the two groups as reported in Table 19b Appendix E-8 cannot necessarily be attributed to the difference in methods used. The interaction between groups and test scores is also significant; this results from the fact that even though the two groups were different at the beginning, both of the groups demonstrated equal competence on the post test and the final test. The lecture group gained at a faster rate but this made no difference on the final test. However, learning was significant for both groups, $p < .001$. See Tables 19 a and b Appendix E-8 for details.

An analysis of the student's responses to the attitude questionnaire revealed that the program was preferred to class discussion in three areas. First as a positive learning experience, the mean rank was higher, $t^{*}(19) = 5.45$, $p < .001$; also the students felt the discussion was too slow in comparison with the program as far as pace was concerned $t^{*}(19) = 2.63$, $p < .05$. The program gave a better sense of direction than the discussion $t^{*}(19) = 4.51$, $p < .01$. For review purposes the students also preferred the program to class discussion $t^{*}(19) = 5.37$, $p < .001$. The program also gave a better sense of direction than the lectures in the opinion of the students $t^{*}(25) = 2.14$, $p < .05$. The lectures were more favorably received than the class discussions in all four areas. As a positive learning experience, the analysis revealed $t^{**}(46) = 2.70$, $p < .05$. The students felt the pace of the discussion was too slow in comparison with the lectures $t^{**}(47) = 2.50$, $p < .05$. The lectures gave the students a better sense of direction than the discussion $t^{**}(48) = 2.44$, $p < .01$. For review purposes the lecture was also preferred to discussion $t^{**}(48) = 4.77$, $p < .001$.

---

* t based on correlated observations

**t based on independent samples.

STUDY 20

Evaluators: Richard Stegner and Jerry Stone, Religion Dept., Illinois Wesleyan University.

Program: Studies in the Gospels by Robert Montgomery.

Course in which program was tested: Two sections of New Testament Religion. Note: This was an experimental course that the students took exclusively during the month of January only. Stegner's section had had a previous course in Old Testament; Stone's section had had no previous course in Religion.

Dates of Experiment: Jan. 5-7, 1966.

Design: Number 3. Group A, program then supplementary lectures; Group B, lectures then programed instruction.

Details of evaluation design: The students were taking only this one course, consequently they could work on it for eight hours each day. The same lectures were given to both groups and the students were expected to work on the program outside of class. The lectures and class discussions were taped.

Results: The amount of learning was significant for both groups, $p < .001$. It made no difference whether the program was presented before or after the supplementary lectures. The analysis of variance revealed no significant differences in method, and there was no interaction. See Tables 20a and b Appendix E-8 for details. Analysis of the students' response to the attitude questionnaires revealed significant differences between the lectures and the program as a method of instruction. The students preferred the lectures to the program as a positive learning experience $\underline{t}^*(56) = 2.18$, $p < .05$. Also the pace of the program was too slow in comparison to the lectures $\underline{t}^*(56) = 3.00$, $p < .01$. However, the program was preferred to lectures for review purposes $\underline{t}^*(55) = 2.02$, $p < .05$. Also the program was preferred to discussion $\underline{t}^*(53) = 5.10$, $p < .001$ for review purposes.

STUDY 21

Evaluator: Fred Wirt, Government Dept, Denison University.

Program: An Introduction to Systematic Analysis in Political Science by Lois Pelekoudas.

---

* t based on correlated observations

Course in which program was tested: Government 211.

Dates of Experiment: Sept. 20 - Oct. 4, 1965.

Design: Number 1. Group A, program; Group C, lectures.

Details of Evaluation Design: Half of each section was assigned randomly to Group A or Group C. The students worked on the program on their own time outside of class. The discussions in class and the lectures were taped.

Results: The program and the lecture groups learned a significant amount of material during the study, $p < .001$. The analysis of variance revealed no significant differences in learning resulting from methods used and there was no significant interaction. See Tables 21 a and b Appendix E-8 for details. The analysis of the student's responses on the attitude questionnaire revealed the following significant differences in mean ranks. The program was preferred to discussion for the sense of direction that it conveyed $t^*(16) = 2.34$, $p < .05$. For review purposes the program was preferred to class discussion $\underline{t}^*(13) = 3.77$, $p < .01$. For review purposes the lectures were also preferred to class discussion $\underline{t}^{**}(42) = 3.69$, $p < .001$.

STUDY 22

Evaluator: Sue McNaghten, Government Dept., Denison University.

Program: Introduction to Systematic Analysis of Political Science by Lois Pelekoudas.

Course in which program was tested: Govt. 211, three sections.

Dates of Experiment: Sept. 20 - Oct. 4, 1965.

Design: Number 2. Group A, program then discussion; Group B, program then lectures.

Details of Evaluation Design: Two sections comprised group A and group B. The students worked on the program on their own time outside of class. The discussions in class and the lectures were taped.

Results: The amount of learning in this study was significant for both groups. The students learned as much whether the program was followed by discussion or followed by a lecture. The analysis of variance revealed no significant interaction. See Tables 22 a and b Appendix E-8 for details.

---

* t based on correlated observations
**t based on independent samples.

The analysis of the student responses on the attitude questionnaire revealed only one area of significant difference in mean rank. For review purposes the program was preferred to class discussion $t^{*}(36) = 2.89$, $p < .01$.

STUDY 23

Evaluator: Roy Morey, Government Dept., Denison University.

Program: Introduction to Systematic Analysis of Political Science by Lois Pelekoudas.

Course in which program was tested: Govt. 211, 2 sections.

Dates of Experiment: Sept. 20 - Oct. 4, 1965.

Design: Number 3. Group A, program then supplementary lectures; Group B, Supplementary lectures followed by program.

Details of Evaluation Design: One section was designated Group A, and the other section was designated Group B. The lectures were taped, and the students worked on the program outside of class on their own time.

Results: The amount of learning in this study was significant for both groups, $p < .001$. There was no significant differences in the amount of learning between the two groups; however, the analysis of variance revealed a significant interaction $p < .05$. The group using the program followed by lectures gained at a significantly faster rate than when the program came after the supplementary lectures. See Tables 23a and b appendix E-8 for details.

The analysis of student attitudes as indicated by their responses on the attitude questionnaire revealed no significant differences in mean ranks for any of the methods of instruction compared.

STUDY 24

Evaluator: William Westbrook, Economics Dept., Denison University.

Program: An Introduction to Systematic Analysis in Political Science by Lois Pelekoudas.

---

* t based on correlated observations

Course in which program is to be used: Principles of Economics 211.

Dates of Experiment: Oct. 1 - Oct. 9, 1965.

Design: Number 4. Four groups: A,B,C,D designated as follows:

	Extra Credit	Work counts on final grade
Volunteers	A	B
Non Volunteers	C	D

Details of Evaluation Design:

Students were asked to volunteer for a unit on political science by programed materials. A similar number of non volunteers were assigned to work through the program as a supplemental unit to the course. Half of the participants, Groups A and C, were then told they would receive extra credit for the unit of work if their performance on the unit test would improve their final course grade. Half of the participants were told that their grade on the unit test would count toward the final course grade regardless of the quality of their work.

Results: Pre-and Post test scores were obtained for all four groups. The amount of learning for all four groups was significant, $p < .001$. There were no significant differences in learning between the volunteer and non volunteer groups. The pretest scores under required versus extra credit were significantly different, $p < .001$.

Therefore the significant difference in learning, F(1.40) = 4.76, $p < .05$, between the group receiving extra credit and the group with required credit cannot necessarily be attributed to the motivational factor of credit for the unit. The analysis of variance revealed no significant interaction. See Tables 24 a and b Appendix C-8 for details.

The analysis of the students' responses on the attitude questionnaire revealed no significant differences in the mean ranks for any of the motivational factors compared.

DISCUSSION

The data substantiate clearly that students do learn from programed materials under a variety of conditions as judged by pre and post test results. Also students can learn as much from programed materials as from other methods of instruction. In the case of the biochemistry program students learned significantly more from programed materials than from either lectures or textbooks covering the same material. It should be recalled, however, that the programs were short ones, taking only two to three weeks of assigned time, with average student time of 5 - 12 hours.

Under design #2, we tried to find out what activity--lecture or question-and-answer discussions--following the use of the program best capitalized on what was learned from the program. The five studies using design #2 did not give any clear cut evidence favoring one activity over another following the use of a program.

The five studies using design #3 gave evidence that a program can be used effectively to introduce a unit of material or for review purposes. Altering the sequence of methods of instruction made no significant difference in the amount of student learning.

Whether students volunteer to learn a unit of material or if it is presented as a required part of the course made no difference in the amount of learning that took place based on the three studies that involved the use of volunteers.

The student attitudes toward programed instruction were more positive than negative. In comparing the methods of instruction over all studies, as a positive learning experience, the order of preference favored lectures, then programed materials, then discussions and finally textbooks. However, Tables B-2 to B-6 indicate that this order varied among the individual programs.

The professors conducting the studies expressed positive attitudes toward programed instruction following their participation. They were not asked to compare programed instruction with other methods of instruction.

MULTIPLE CORRELATION ANALYSIS

The final treatment of the data consisted of computing multiple correlations from the data of each of the five programs that the project evaluated. Twenty variables that were included in the multiple correlation are given below and may be found in their original wording in Appendix E-6.

1. Sex
2. Class in college
3. CEEB-M (College Entrance Examination Board, Math scores)
4. CEEB-V (Verbal)
5. Pre-test score for each program
6. Post-test score for each program
7. Rank in high school class
8. Q-2A Amount of time spent on the program
9. Q-4A Evaluation of the program from very positive to very poor

10. Q-5A Pace of the program from too fast to too slow
11. Q-6A Sense of direction in using the program from "never in doubt" to "lost most of the time"
12. Q-7A Ease of review, from very easy to very difficult
13. Q-8A Rated programs against traditional ways of being taught from programs better than, to programs less good than
14. Q-9 Rating of course in which program was used from most liked to least liked
15. Q-10A Effect of program on attitude toward the course from favorable to unfavorable
16. Q-11A1 Evaluation of program from boring to stimulating
17. Q-11A2 Evaluation of program from too hard to too easy
18. Q-11A3 Evaluation of program from efficient to inefficient
19. Q-11A4 Evaluation of program from delightful to irritating
20. Q-12 Have you used program materials before?

Means, standard deviations of each of the variables and N's of each of the five GLCA-produced programs that were evaluated are given in Appendix E-11. In computing the multiple R's the Post-test score was used as the criterion variable against which the other variables were correlated. Variables 3, 4, and 5 were forced for each program, and thereafter the correlation proceeded to each of the highest partial coefficients until only insignificant ones remained.

Results

The table of partial correlation coefficients for variables 3, 4, and 5, and amount of variance accounted for by these Variables is given in Table 8.

Table 8--Variance Accounted for by Variables 3, 4, and 5*

	Program				
	1	2	3	4	5
When Variable 3 is correlated with criterion					
F Ratio	2.11	62.49	2.32	6.11	.94
n.d.f.	150	195	213	153	149
Multiple R	.1178	.4926	.1038	.1959	.0792
Multiple R square	.0139	.2427	.0108	.0384	.0063
When Var. 4 is correlated with criterion, including Var. 3					
F Ratio	19.19	2.73	.41	1.41	16.09
n.d.f.	149	194	212	152	148
Multiple R	.3555	.5032	.1125	.2174	.3220
Multiple R square	.1264	.2532	.0127	.0473	.1037
When Var. 5 is correlated with criterion, including Var.3,4					
F Ratio	5.88	4.63	.18	15.59	15.44
n.d.f.	148	193	211	151	147
Multiple R	.3997	.5203	.1161	.3693	.4346
Multiple R square	.1598	.2707	.0135	.1364	.1889

* Variable 3 is CEEB-M, Variable 4 is CEEB-V, Variable 5 is the Pre test.

Variable 3, CEEB-M is most highly correlated with the criterion, the post test scores of the Logic program (2) but is not significantly related to success on the Political Science program (5) both of which are reasonable findings. What is less understandable is the significant positive correlation of CEEB-M scores with success on the Religion program (4).

Variable 4, CEEB-V is significantly correlated with the Poetry (1) and Political Science programs, less so with the Logic and Religion programs, and not significantly correlated with success on the Biochemistry program (2).

Variable 5, the pre-test designed for each program is not significantly correlated with post test scores on the Biochemistry program but is for all the rest of the programs, especially for the Religion program where it accounts for a good deal more of the variance than do CEEB-M and CEEB-V.

The Multiple R's for the three variables range from a low of R = .1161 for the Biochemistry program to R = .5203 for the Logic program. The amount of variance (square of multiple R) accounted for by the three variables ranges from a low of 1.35 percent for the Biochemistry program to a high of 27.07 percent for the Logic program.

The table of partial correlation coefficients after Variables 3, 4, and 5 were partialled out are given in Table 9.

Table 9--Partial Correlation Coefficients for each Program After Var. 3, 4, and 5 were Partialled Out

Variable	1	2	3	4	5	Code
1. Sex [redacted]F	.07	-.16*	.06	.10	.27*	1M 2F
2. Class [redacted]	-.25*	.09	.22*	.06	.04	1F 2S 3J 4Sr
3. CEEB-M	.00	.00	.00	.00	.00	Math Score.
4. CEEB-V	.00	.00	.00	.00	.00	Verbal Score.
5. Pre-Test	.00	.00	.00	.00	.00	Pre-Test.
6. Q-12	-.12	-.03	-.03	.16*	.05	Used PI before 1Yes 2No
7. Rank in HS class	-.04	.02	-.01	-.30*	.13	0 to 100
8. Q-2A	-.16*	-.01	.08	.04	.21*	Time spent on PI to nearest hour 10 to hi
9. Q-4A	-.08	-.20*	-.09	-.16*	-.09	Eval. of PI. 1 very positive, 5 very poor
10. Q-5A	.04	-.08	.15	-.02	-.10	Pace. 1 too fast, 2 about right, 3 too slow, 4 uneven
11. Q-6A	.00	-.17*	.00	-.28*	-.03	Sense of direction. 1 never in doubt, 5 lost most of time
12. Q-7A	.08	-.01	.02	-.16*	-.04	Ease of review. 1 very easy, 4 very diff., 5 did not review
13. Q-8A	-.19*	-.01	-.08	-.19*	-.13	Rate PI to texts, etc. 1 highest, 4 lowest
14. Q-9	-.13	-.07	.05	.09	.03	Rate course. 1 most liked, 2 least liked
15. Q-10A	-.10	-.13	.01	-.14	-.19*	Eff. of PI on att. to course. 1 favorable, 3 unfavorable
16. Q-11A1	-.08	.16*	.00	.17*	.18*	Eval.of PI. 1 boring, 5 stimulating
17. Q-11A2	.16*	.35*	.07	-.07	-.11	Eval.of PI. 1 too hard, 5 too easy
18. Q-11A3	.03	-.09	.01	-.17*	-.03	Eval.of PI. 1 efficient, 5 inefficient
19. Q-11A4	-.08	-.28*	.05	-.22*	-.05	Eval.of PI. 1 delightful, 5 irritating
20. Post-Test	1.00	1.00	1.00	1.00	1.00	Criterion
Multiple R	.5597	.6368	.3485	.5786	.5632	
Mult. R Square	.3133	.4055	.1215	.3347	.3172	

* p = <.05

For program 1, 13 variables were partially correlated to obtain the multiple R. (3 4 5 2 17 16 13 14 1 8 15 18 19)

For program 2, 6 variables were partially correlated. (3 4 5 17 19 1)

For program 3, 10 variables were correlated. (3 4 5 2 10 9 19 6 17 18)

For program 4, 10 variables were correlated. (3 4 5 7 11 6 12 13 1 2)

For program 5, 10 variables were partially correlated. (3 4 5 1 8 15 13 9 17 2)

Discussion

The first column gives the partial correlations of the 17 remaining variables with the criterion variable, the Post-test, after Variables 3, 4, and 5 were partialled out for the Poetry program. The coefficient of Variable 2 (r = -.25) indicates that the lower the class level of the student the more probability of his receiving a higher post-test score. In other words freshmen and sophomores did better on the post-test than did juniors and seniors. The coefficient of Variable 8 (r = -.16) just reaches significance and indicates that the amount of time spent on the program was negatively correlated with success on the post-test. The tendency was for students who spent less time on the program to obtain higher scores on the post-test. The coefficient of Variable 13 (r = -.19) indicates that those students who rated programed instructional materials against texts, lectures and discussion tended to rate the programs more favorably. The positive correlation on Variable 17 (r = .16) indicates that the program tended to be evaluated as too easy.

The second column contains the parital correlation coefficients for the Logic program. The partial coefficient of correlation for the first variable is -.16. This indicates that success on the post-test was negatively correlated with sex, as it was coded. Male students tended to do better than female students. On Variable 9 (r = -.20) was found indicating that the students tended to rate the program as a positive learning experience. On Variable 11, the coefficient of -.17 showed that not being in doubt about the direction of the program varied with success on the post-test. Variable 16 (r = .16) shows a positive relationship between rating the program stimulating and success on post-test score; and Variable 17 (r = .35) indicates that evaluating the program as being easy tended to be associated with success on the post-test. In addition, Variable 19 (r = -.28) shows a relationship between rating the program on the "delightful" side of the scale and success on the post-test.

The Biochemistry program had only one significant partial correlation, that of Variable 2 (r = .22) with the criterion variable, the post-test. In contrast with the Poetry program, the Biochemistry program favored upper classmen. The positive correlation with the criterion indicated that upper level students tended to receive higher scores on the post-test.

The Religion program, No. 4, had the largest number of significant partial correlations of variables with the criterion variable. Variable 6 (r = .16) indicated a relationship between not having used programed instructional materials before and success on the post-test. Conceivably this result might be related to the fact that the Religion program had a format that was most radically different from typical programed format. Variable 7 (r = -.30) showed a relationship between the rank in graduating class in high school and post-test scores, those tending to be toward the lower side of the rank doing better on the post-test, indicating the possibility that the program favored the somewhat slower student. Variable 11 (r = -.28) indicated a relationship between a student's feeling that he was never in doubt about his sense of direction when using the program and his success on the post-test. Ease of review, Variable 12, (r = -.16) and rating programed materials more favorably than other methods, Variable 13 (r = -.19) were also correlated with success on the post-test. In Variable 16, (r = .17), rating the program as being stimulating was correlated with success on the post-test, as was Variable 18 (r = -.17) evaluating the program as efficient and Variable 19 (r = -.22) evaluating the program as delightful.

Program 5, Political Science program, had six significant partial correlations. The first variable, the sex of the student, showed a positive correlation between being a female student and success on the post-test (r = .27) in contrast to the Logic program where men students did better. It may be significant that the author of the Political Science program is a woman. Variable 8 (r = .21) tended to show a positive correlation between the amount of time spent on the program and success on the post-test. This is in contrast to the Poetry program which showed a negative correlation between time spent on the program and success on the post-test. Variable 15 (r = -.19) is to be interpreted to mean that favorable attitude toward the course as a result of using the program tended to be related to success on the criterion variable. Variable 16 (r = .18) showed some relationship between evaluating the program as stimulating and high score on the posttest.

Summary of amount of variance accounted for by Variables 3, 4, and 5, and the remaining variables, is given in Table 10.

Table 10--Variance Accounted for by Variables used in Computing Multiple R's

	Program				
	1	2	3	4	5
Percent of Variance Accounted for by Variables 3 4 5	15.98	27.07	1.35	13.64	18.89
Percent of Variance Accounted for by Remaining Significant Variables	15.35	13.48	10.80	19.83	12.83
Total percent of Variance Accounted for by Multiple R's	31.33	40.55	12.15	33.47	31.72

The total variance accounted for by the Multiple R for each program is 31.33 percent for the Poetry program, 40.55 percent for the Logic program, 12.15 percent for the Biochemistry program, 33.47 percent for the Religion program, and 31.72 percent for the Political Science program.

In the Logic and the Political Science programs the greatest percentage of variance is accounted for by Variables 3, 4, and 5. The opposite is true of the Religion and Biochemistry programs where the greatest percentage of variance is accounted for by the remaining significant variables. Variance on the Poetry program is accounted for about equally by both sets of variables.

Summary

The Poetry program appeared to be the easiest program, appropriate for underclassmen, yet favorably compared to other methods of instruction. The Logic program seems to be well suited for men students, and tended to be rated as easy, delightful, and a positive learning experience by those who also scored high on the criterion. Mathematical aptitude accounts largely for success on the Logic program. The table of partial correlation coefficients yields little information about the Biochemistry program other than that the upperclassmen tended to do better on the post-test than did the underclassmen, indicating perhaps that it is a demanding program. The Religion program tended to be easy for slower students and was generally rated favorably. Both Religion and Political Science programs probably built more on students' previous knowledge than did the other programs. The Political Science program favored women students and those who spent more time on it than those who did not. It was the only program to affect the student's attitude positively toward the course, and along with the Religion and Logic programs, was considered stimulating.

CONCLUSIONS AND IMPLICATIONS

That students learned from programed instruction and expressed favorable attitudes toward it, and that professors were favorably impressed with the programs used, indicate that programed instruction is worthy of continued consideration as a legitimate medium for teaching at the college level under conditions comparable to those of the evaluation designs. Programs were successful for differing reasons. Given appropriate information about students, it is possible to ascertain variables that are associated with success in using the program as measured by the criterion variable, the post-test.

Part III   Impact of Preparing Programed Materials

Chapter 7

CHAPTER 7

THE PROCESS OF PREPARING PROGRAMED MATERIALS AS A MEANS OF ILLUMINATING TEACHING

The arrival of programed instruction on the educational scene with the accompanying process of preparing programed materials has made possible the radical development of an important aspect of the total process of teaching - - the planning of learning activities. This is not to suggest that planning for learning was not an important part of the instructional process prior to the advant of programing. Preparing programed material as was done on the GLCA Programed Instruction Project, however, involved a quality and intensity of planning that goes far beyond anything done in the past in the traditional approach to college teaching. Robert Gagne[17] calls this kind of planning predesigning of learning conditions. Programing has thrown into bold relief the difference between two methods of planning or designing learning conditions: the traditional extemporaneously designed learning conditions, and predesigned learning conditions.

As Gagne[18] states, learning conditions can be predesigned (and thus, in a sense, become a part of planning), or they can be designed to meet each instructional situation as it arises.

One of the most fundamental methodological questions that a teacher now needs to answer is the extent to which the learning situation can be and should be predesigned for the individual learner and the extent to which it can be created extemporaneously, while instruction proceeds over a period of time.

Gagne[19] points out that extemporaneously designing the conditions of learning while the teacher is interacting with a student or students is undoubtedly considered by many teachers to be one of their most important functions. Many instructors consider personal involvement with students to be the heart of the matter of teaching. It is on their skill in extemporaneously designing the conditions of learning that they pride themselves. It is in such activities that some of the deepest satisfactions from teaching arise. Extemporaneously designed learning conditions constitute what might be called the art of teaching.

---

[17] Robert M. Gagne, The Conditions of Learning, New York: Holt, Rinehart and Winston, Inc., 1956.

[18] Ibid., p. 250.

[19] Ibid., p. 251.

underscore

Extemporaneously designed learning conditions have certain disadvantages, however. It is peculiarly difficult to assess the effectiveness of extemporaneously planned conditions of learning or to clarify what kinds of learnings are enhanced by such teaching. It is also difficult to train a person in techniques of this art.

Although predesigned learning situations as exemplified in programed instruction are in many respects the polar opposite of extemporaneously designed situations, the two are not mutually exclusive. In fact, they complement each other. Just as there are advantages to the extemporaneously designed conditions of learning, so there are advantages to the predesigning of learning conditions. Gagne[20] states the following:

1. The selection of proper learning conditions can and may be made as an unhurried choice rather than in spur of the moment decisions.

2. A quality control of the learning conditions is insured and maintained. Quality does not suffer from variations in teacher's skills.

3. Predesigning makes possible pretesting; whether or not a set of learning conditions has been correctly chosen and designed can be determined by trying it out on the students and revising if necessary.

4. Predesign of learning conditions greatly reduces the necessity for the teacher to use valuable time in extemporaneous design and thus makes it possible for a proper emphasis to be restored to the teacher functions of managing instruction, motivating, generalizing, and assessing.

The illumination of hitherto relatively unexamined aspects of teaching was one of the unanticipated by-products of the Project. Little research has been done on the relationship of preparing programed material to broader aspects of teaching. Lysught[21] showed that teachers trained to prepare programed materials used more programs subsequently in their classroom work expressed more favorable attitudes toward programs, found programing intrinsically satisfying. No control group was used in the study. Testimonial evidence abounds as to the salutary effects that preparing programed materials has on the understanding of teaching.

---

[20] Gagne Ibid., p. 253

[21] Jerome Lysaught, "Inducing Classroom Change Through Programer Training," Programed Instruction Bulletin Vol V. No. 1, October, 1968, p. 11.

The remaining chapters will report more systematic evidence that principles and techniques of programing have broad applicability to other aspects of teaching.

The following assertions seem warranted and will serve to summarize the material that will be presented in this chapter and tested more systematically in the following chapters.

1. The process of preparing programed material can be described in at least a schematic manner.

2. Preparing programed instructional materials-a method of predesigning learning conditions-sheds light upon other major aspects of teaching.

3. The principles and methods used to prepare programed materials on the Programed Instruction Project differ in many respects from earlier principles and procedures.

The Process of Preparing Programed Material

The GLCA Programed Instruction Project asked more of program writing than the mere production of programs effective as they might be as teaching devices. The Project sought in the preparation of programed instructional material, a process that would generate new insights into some of the fundamental dimensions of teaching. If the process of writing programs could be made to illumine the broader domain of teaching the value of the process would extend beyond the mere preparation of programs into the very teaching procedures used by the programers as college instructors. In addition, programed instruction itself would be validated at least in part by its contribution to the total teaching effectiveness of the authors.

An attempt was made to find consultants for the training workshops provided for the programers during the summers of 1964 and 1965 who would be able to provide the training experiences that would go beyond the simple production of programed material that would generalize to the broader aspects of teaching. Such consultant help was made available to the project by the Center for Research on Learning and Teaching of the University of Michigan which set up the training workshop in the Summer of 1964 and provided editorial service to the GLCA Programers. In 1965 the training workshops were conducted by the staff members from within the Great Lakes Colleges Association.

The following is a generalized scheme to describe how programed instructional materials were prepared on the GLCA Programed Instruction Project. Like all schematic descriptions, however, it does not fit reality completely. The reader should bear in mind that

E

there were many exceptions to the procedures as outlined below. We soon discovered that there is no single universal approach to the preparation of programed materials and that there were as many individual variations from the general scheme as there were programers. Although the programing done on the GLCA is not unique in toto, it has some features about it that are.

Ordinarily the first step in preparing programed material is taken when the programer delineates in a rather general way the topic or subject he wishes to program. The first step may be no more than giving the forthcoming program a tentative title and blocking out some of the areas of knowledge to be covered by the program. It was not unusual to find at this stage that the programer underestimated the complexity of preparing programed material and aspired to program much more material than was feasible in one summer's time. When this happened, the programer was advised to begin to program only a small part of the content he planned to cover.

The programer took the second step in programing when he formulated the objectives of his program. The purpose of stating objectives is to set up a guide for the selection of material to be included in the program and to establish a standard of performance which the student is expected to be able to meet at the conclusion of the program. If this purpose of stating objectives is to be fulfilled, objectives need to be stated in much more detail than is generally done in teaching. Much more attention needs to be paid to formulating the objectives in terms of student behavior and performance than is usually the case. Programers in the GLCA project found that their broad overall objectives needed to be broken down into a more detailed outline of objectives, stated in terms of what students were expected to accomplish, and formulated insuch a way that the program content could be derived from them.

Mager's book PREPARING OBJECTIVES FOR PROGRAMED INSTRUCTION[22] was useful in helping many faculty members catch the idea of writing objectives precisely and in verifiable terms.

Experience on the project has shown that college professors typically stated their objectives in terms that were much too gross to be useful in directing what and how they taught. They often included objectives that were far broader than they could possibly expect students to attain. Although there is no objection against broadly formulated objectives as such, they need to be made much more specific than is generally the case if they are to serve as explicit guides to the instructor's content and teaching procedures.

---

[22] Robert Mager, Preparing Objectives for Programed Instruction, San Francisco: Fearon, 1962.

Furthermore, the college teacher often mistakes teaching for learning. He often states as an objective what he will do rather than what students will accomplish. Rather than stating what he wants the student to know and be able to do at the termination of the course he specifies what he as an instructor will do during the course to help the student arrive at that point.

This is not to say, however, that every program writer successfully formulated precise and specific objectives for his program the first time he turned his hand to it. Some of them never did succeed in satisfactorily formulating their objectives in such terms. In one or two cases it might even have been better for the programer not to have been so concerned about formulating his objectives, since trying to do so seemed to set up a mental block that impeded progress on the further steps of program writing. The process of formulating objectives was not meant to be a fetish although to some programers it became almost that. Neither was the stating of objectives set up as a hurdle which needed to be completely cleared before any further steps could be taken on writing the program.

Nevertheless in spite of some exceptions it still remains true that no step in the entire process of writing programed material made a greater impact upon the programer's understanding of teaching than learning how to formulate specific verifiable objectives.

The attempt to formulate objectives in some cases illumined the tentative title and outline for a programer and suggested to him how to rephrase his tentative title and re-delineate his subject matter. After the first more or less successful attempt to formulate objectives the programers usually went on to the next step in their writing of the program to return later to the problem of formulating their objectives more clearly. Going back to reformulate the title and subject matter after having stated the objectives was only one of the many occasions in which a programer during the course of preparing programed material reorganized what he had previously written in the light of new insights gained in taking the forward step. The preparation of programed material consisted of a moving up and down the line readjusting, reorganizing, redefining, rather than a precise neat and logical unfolding of the material.

The next formal step in the preparation of programed material was the construction of two comparable forms of a test, called a "criterion test," that were suitable to assess the success of the student in attaining the objectives of the program. By taking this step the programer came to grips with the directing function of his objectives. That is, if he really meant that a student taking his program was expected to attain the objectives he had formulated for the program, then it followed that the programer should establish testing procedures to ascertain whether the student had in fact attained the objectives.

The instructor was introduced, perhaps for the first time, to all the bugaboos of testing - validity, reliability, objective versus subjective questions. Construction of adequate tests is a complex technical skill which most college instructors do not possess and cannot be expected to develop in the short time usually available to them for writing programs. The very process of preparing adequate test materials deserves a training workshop in its own right. Consequently, the instructor's success in producing a sophisticated instrument for assessing student's progress toward the objectives of his program is likely to be limited. None-the-less, the attempt to develop such tests probably helped the programer develop a clearer perspective of his objectives which he now stated in even more verifiable terms.

One form of the criterion test served as a "final exam" of the program. The second form of the test could serve quite a different purpose, although not every programer used it so. The criterion test was constructed parallel to the outline of objectives. The test itself can become a second outline of the program called the "Criterion Frame Outline." Each question of the test is designed to ascertain the student's success in attaining a specific objective. The test can therefore be taken apart, question by question, each question serving as a check point for a specific objective, to measure the student's progress as he proceeds through the program. The last item on the test serves as the last "criterion frame" of the program. The first test item is the first criterion frame. Both the outline of objectives and the series of test items imbedded in the program serve as the framework around which the program is built. As the student works his way through the program both he and the instructor can gauge his progress by his success in answering the criterion frames which serve as checkpoints for the objectives and form the outline of the program.

The final exam could serve not only as the test of the success of the student in attaining the objective, but could also be used as a pretest to determine the student's initial knowledge of the material in the program. He could possibly be excused from taking those parts of the program in which he demonstrates his initial proficiency. In practice, however, the instructor may wish a student to take the entire program reviewing those parts on which he demonstrated his proficiency.

Experience in training programers suggests that much more attention should be paid to the criterion frame outline than is usually the case. Brethower[23] points out that once the outline is

---

[23] Dale M. Brethower "Finding and Using Criterion Frames" Selected NSPI Talks, 1965, Occasional Paper No. V, Ann Arbor: University of Michigan, Center for Program Learning for Business, 1965, p. 38.

underline Selected etc.

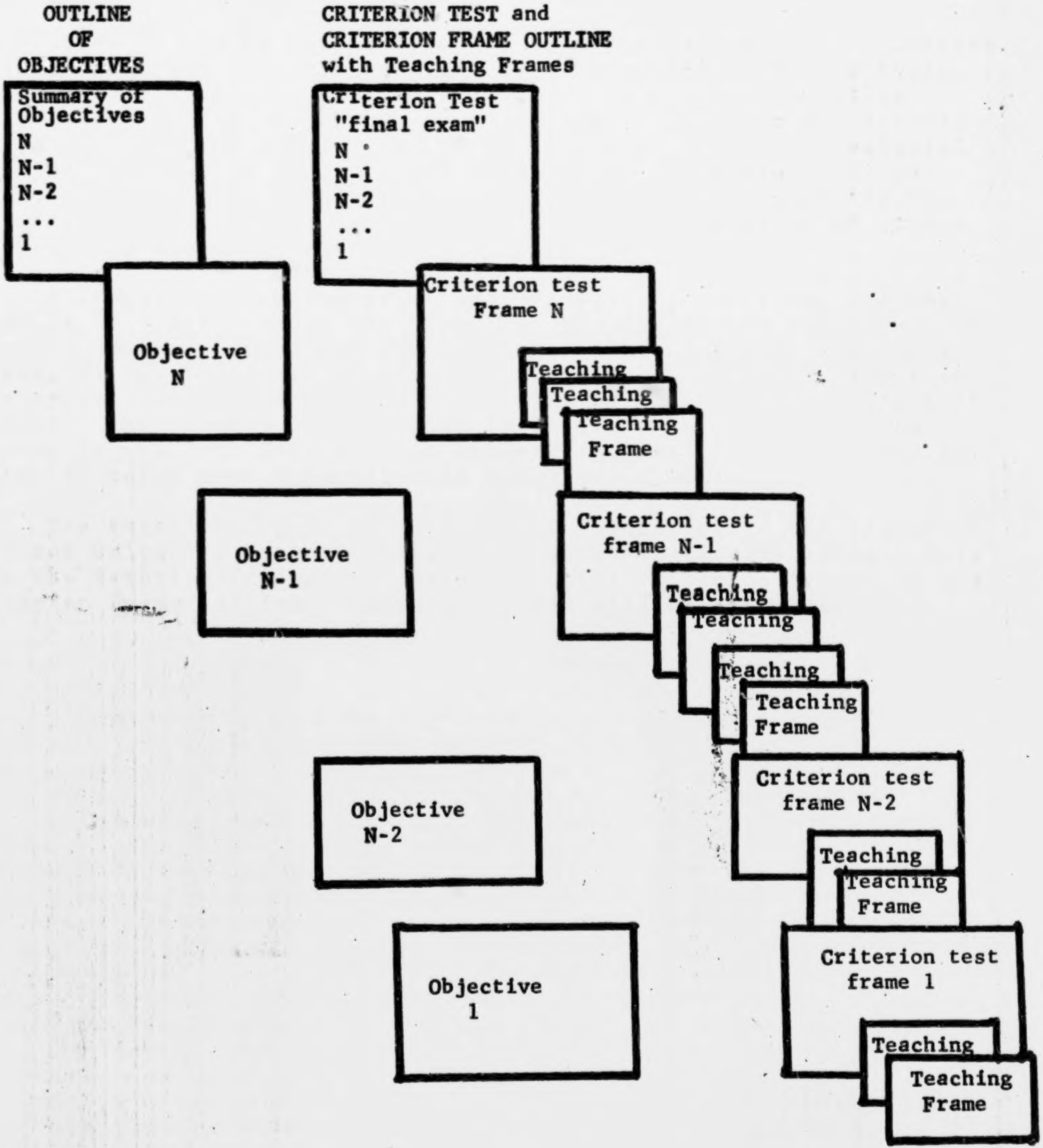

OUTLINE OF OBJECTIVES
CRITERION TEST and CRITERION FRAME OUTLINE with Teaching Frames
Summary of Objectives
N
N-1
N-2
...
1
Criterion Test "final exam"
N
N-1
N-2
...
1
Objective N
Criterion test Frame N
Teaching
Teaching
Teaching Frame
Objective N-1
Criterion test frame N-1
Teaching
Teaching
Teaching
Teaching Frame
Objective N-2
Criterion test frame N-2
Teaching
Teaching Frame
Objective 1
Criterion test frame 1
Teaching
Teaching Frame

Fig. 1 - - Diagram of Relationship
of
Objectives and Criterion Outline

constructed it can be used 1) to make a "market survey" of colleagues to ascertain from them whether they are interested in having their students able to answer such questions, 2) to discover critical skills which should be taught, 3) to determine relevant characteristics of the student population, 4) to eliminate irrelevant material from the program, 5) to check the accuracy of the content, 6) to separate educational problems from problems of supervision, 7) to generate other criterion frames, 8) to enlist cooperation of others in designing the program, 9) to advertise the program.

A comment on the degree of specificity of objectives and test items is in order. After the programer has stated his objectives in specific testable terms and has developed criterion test items and frames, he may then wish to "loosen" his objectives by stating them more broadly and by making his test items on the criterion test more general. The purpose of loosening is to assure himself that the program is not just teaching the student to pass a specific test but rather to teach more generalizable behavior as well.

The relationship of the Outline of Objectives to the Criterion Test and Criterion Frame Outline is shown schematically below. Note also the teaching frames that lead up to the criterion frames in the Criterion Frame Outline. Teaching frames will be discussed next.

Having organized his objectives into an outline and having developed two parallel criterion tests, one to serve as the final test and the other as a criterion frame outline parallel to the outline of objectives, the programer was now in position to take the next step in the preparation of programed material, the writing of "teaching frames." The teaching frame is the unit of information to which the student responds. By means of the teaching frames, set up in a sequence, the programer presented to the student the information, problems, stimuli to be discriminated, concepts to be formed or whatever the students need to know and do in order to pass the criterion frames. The decision of what goes into the teaching frame is determined by the criterion test frame toward which the teaching frames are expected to lead the student. The criterion test in turn is determined by the objectives. Thus in a real way the objectives guide the selection of material to be included in the program.

The programers at this point faced a dilemma between trying to motivate students and being sure that they retained what they learned. For the sake of maintaining the motivation of the student the programs were kept as "lean" as possible. That is, no more teaching frames than necessary were used to prepare the student to pass the test frame. For the sake of retention, however, a certain amount of redundancy needed to be provided in the teaching frames. Too much redundancy jeopardizes motivation; too little jeopardizes retention. It was found that redundancy could be provided by "branching techniques" whereby the students who desired or needed more examples problems, information, as shown by their failure to pass the criterion test frame could practice the responses by taking an extra branching line of teaching frames.

Generally speaking, the program writers for the GLCA Programed Instruction Project adhered to the principle of obtaining active responses from the students who were to take the program. Aside from that principle, however, they paid little attention to set rules for writing teaching frames as was advocated by some program writers and editors. The programers did not, for instance, use a low error rate as a criterion of the success of the program. When errors did occur, it was not automatically assumed that the "step size" was too large. The programer sought the source of the error in possible ambiguous wording of the teaching frame or in possible inadequate sequencing of the material. In some cases earlier material that had not been practiced enough for the student to have retained was the cause of errors in later frames.

Writing teaching frames was the starting point of the earlier generation of programers, and is to some extent still considered the starting point for writing programs.[24] As seen from the above, however, the new generation of programers as typified by the GLCA programers did not write teaching frames until a great deal of preliminary analysis and tentative formulations had been completed.

The actual writing of the teaching frames, however, served to illumine and clarify all the previous steps. Thus, after writing a sequence of teaching frames, a programer might find it necessary to revise his criterion frames or even his objectives. Although we have no experience to verify the following statement, it is probably true that a programer after writing a successful program following the ideal schematic procedure outlined herein could thereafter begin almost at any point in the sequence with the writing of a program. The training program, however, followed rather closely the steps outlined so far in order to provide a frame of reference for the inexperienced programers.

Although the content of teaching frames is determined by the criterion frames and ultimately by the objectives of the program, the sequence of the teaching frames and ultimately of the criterion frame outline itself is to be determined empirically. That is, the programer as a subject matter specialist and perhaps in consultation with colleagues, is the person best qualified to decide on the nature of the objectives and the subject matter and skills which a student must know in order to attain the objectives. But the sequencing of the teaching frames and ultimately of the criterion test items and the objectives is a problem of a different order whose solution is not directly derivable from knowledge of the subject matter itself. Being an expert in the content of a discipline does not insure the instructor's being an expert in communicating it in a learnable sequence. To the problem of sequencing we now turn our attention.

A college instructor rarely, develops the sequence of material in his course or in a lecture on an empirical basis. In interviewing a number of college instructors the author discovered that it was a practically unheard of practice for an instructor to try out a sequence of lecture or reading material on one or two students to ascertain from them whether the material was presented in clear and understandable form. This is not to say that instructors do not get feedback from students. The mechanics of feedback in a typical college instructional setting, however, are generally too crude to provide an adequate means whereby an instructor can empirically improve the sequence of the material he presents.

---

[24] Julian Taber; Robert Glaser and Halmuth Schaefer, Learning and Programed Instruction, Reading, Mass.: Addison-Wesley, 1965, p. 140.

Where does an instructor typically find a basis for developing a sequence of material? He can and often does find it in the outline of chapters that appears in the textbook. He may use some logical basis, moving from simple to complex, from known to unknown, or from the presentation of principles to examples. He may present the material chronologically. Or a college instructor may look inward and organize his material in terms of what interests him most to what interests him least, from what he is most competent to teach to what he is less competent. The way the instructor has been taught in college and graduate school is still another basis to be used in organizing the material he wishes to teach.

Two experiences of programers called into question the above traditional approaches to sequencing subject matter. The first experience occured when the programer was confronted with the objectives and the criterion outline he had formulated. He now was required to write his first teaching frame. What should go into it? How should it be phrased? What can be assumed about the student? Answering those questions can and often did constitute a minor crisis in the programer's life. The reason is clear. It is by no means certain that we know everything that is important to be known about beginning a program. A programer discovered how many unverified assumptions he had been making about what students know, how much uncertainty they will tolerate in getting started, how much he depended on factors generated by his own personality in getting a course or lecture underway. Programing brought such assumptions into the open for closer scrutiny. Much more empirical study needs to be made of how initially to engage a student in a program, or for that matter, a lecture or a course.

Having worked through the minor crisis of getting started, and having developed a tentative teaching frame sequence, the programer encountered a major crisis when for the first time he presented his teaching frame sequence to a real student who served as a test subject for a trial run of the embryo program. At this point the programer discovered whether or not his initial teaching frames and the following sequence actually did communicate to the student what the programer wanted it to. Did it start the student on the line of thinking that would lead him to the attainment of the objectives of the program?

One of the most helpful questions a programer can ask himself in beginning to write a program is "What does the student have to know in order to pass the first criterion frame of my program?" The steps that a student must take, the information he must possess, the problems he must solve in arriving at the point where he can answer the question provide the substance of the first teaching frames. Some content lends itself to being analyzed into a series of steps leading up to the criterion frame. The programer can best proceed empirically in deciding how many of the steps must be included, whether the first step should be presented first to the student, or

tself

student, or whether he should be presented with the last step first and then be worked backward through the steps stopping at any point at which he is able to pass the criterion test.

However, any a priori analysis of the sequence of the material does not quarantee that it will necessarily mesh with the mental operations performed by the students taking the program. At the present time we know relatively little about the mental operations a student uses in the interacting with programed material. Bloom's TAXONOMY OF EDUCATION OBJECTIVES[25], Guilford's structure of intellect[26] and recent advances in computer simulated thought processes[27] give some promising leads for investigating mental processes involved in human learning. Programing provides the experimental tools for carrying out the investigation.

There is, however, a more immediate reason for the relative lack of knowledge of how to sequence materials in a way congruent to the student's mental operations. The reason is that educational objectives are rarely formulated for or addressed to students themselves. To whom are educational objectives usually addressed? Probably more to the imagined and real colleagues of the programers than to real students themselves. If objectives were addressed to students and were meant to communicate to them what the program was designed to teach them in terms that they could understand and visualize, it might be possible for the programer to go directly to the students themselves with the objectives and ask them to tell him, the programer, what information or skills they thought they would need in order to attain the objectives.

This is not to say that it is a simple matter to communicate educational objectives to students. How does a teacher communicate to students what they do not yet know? In spite of the difficulties, exploring the students' responses being given the objectives for their learning should be explored and might uncover new strategies of sequencing subject matter that are more congruent with their mental operation than any apriori, abstract approach to sequencing that we now use. A possible additional benefit of communicating directly to the students the objectives of the program or the course is that the process of communicating might tend to break them away from their dependence (shown by so many college students) on the instructor not only for the objectives of education but for the means of education as well.

---

[25] Benjamin Bloom, A Taxonomy of Educational Objectives

[26] J. P. Guilford, "Three Faces of Intellect," American Psychologist, 1958, 14, 469-479.

[27] Allen Newell, Herbert A. Simon, and John C. Shaw, "Elements of a Theory of Human Problem Solving," Psychological Review, 1958, 65, 151-166.

Programing differs from other modes of presenting subject matter in that it is developed empirically. Early in the process of programing typical students were called in so that the programers could try out their programs on them. The purpose of the programer was not to defend his program against the student's criticism of it but rather to invite criticism and to learn how well the program taught by observing student reaction to it. The program was presented to the student under conditions that resemble as nearly as possible the conditions under which the program will normally be used as a predesigned, auto-instructional device. The programers were instructed not to ad lib, suggest answers, give instructions that would be impossible for another instructor using his program to give under normal conditions. The programer's main job was to listen, observe, take notes on how the student reacted to the program. When the student had worked his way through it, the programer went over it with him, rephrasing parts of it if necessary, making the instructions still more explicit, dropping out a frame here or adding one there. But the ultimate test of the program was the student's success in answering the questions on the criterion tests. In general, if the test measures what it purports to measure (i.e., is valid) and does so under a variety of conditions (i.e., is reliable) and if a student after taking the program passed the test which he could not have passed before taking the program, the programer is on his way to having developed an empirically validated teaching technique.

The process of developing a program up to this point constituted one of the most important phases of learning about teaching for the programer. Further drafting of teaching frames, reviewing them, trying them out both on students and colleagues provided still more opportunities for the programer to learn not only more about the content of his discipline as it is contained in his program but also about the learning processes which students use as they work with his program. Even as specialists in their disciplines the programers frequently found that they had a less precise understanding of their material than was required by programing.

One of the greatly under-emphasized aspects of program writing is the value of the programer's consultation with other colleagues who critically evaluate the content of the program. An attempt was made in the Programed Instruction Project to surround the programer with a team of consultants who could help him not only in the technical aspects of writing the program but also in the specialized aspects of the content of the program. Many simply procedural and mechanical difficulties were encountered in trying to set up such a consultantive team for each programer. A more fundamental difficulty, however, grew out of the nature of programed instructional material itself. Such materials are very explicit. A programer's assumptions, his point of view, his predilections and interpretations are immediately visible in a program. These, of course, constitute the sources for major differences among acedemic people. As S. Markle[28] said, "I must admit that scholars disagree -- rarely on facts, sometimes on definitions, often on theories, and almost always on interpretations." It takes a great deal of sophistication and tough mindedness on the part of both the programer and the consultant to develop a fruitful consultative relationship for the production of programs.

When the final draft of a program was completed it was field tested (See Chapter 2). A field test yields different information from the developmental testing. As indicated in Chapter 2, field testing usually provides a redundancy of data, much more than a programer can use. By sampling the data from field testing, however, programers found they could learn as much about the operation of a program as they could in using all the data. Field testing also provided information on problems of administering the program in a typical classroom or college teaching situation. Such information proved to be valuable in helping the programer write more adequate instructions for the use of his program. Finally, field testing provided the kind of information that should be presented to the potential consumer of the program to help him decide whether to use the program and if so, how to use it. In a sense, a program as a validated teaching technique is comparable to a standardized test. To be useful a standardized test needs to provide information on the norms of the test, that is, on the population on whom the test was standardized. Such information is also valuable in describing the purposes and the success of the program in doing the teaching job for which it is designed.

In summary, what can be learned from the process of preparing programed material that is applicable to the more traditional activities of a teacher -- holding lectures, discussions, tutorial sessions, and evaluating student progress? Experience in the GLCA Programed Instruction Project suggests that the following steps in preparing programed material shed light upon other teaching processes:

1. Formulating objectives in observable testable terms.

2. Writing criterion test items that validly and reliably assess the students' progress toward the objectives.

---

[28] Susan Markle, "The Wastebasket Reflex. A response to Some Exemplars of the Art", NSPI Journal No. 5, May 1965, p. 10.

3. Selecting the content of the program in terms of the objectives.

4. Arranging the content in a sequence in terms of our as yet rather inadequate understanding of the student's mental processes, and styles of learning.

5. Developmental testing of the teaching sequence of the program - trying out sequences of teaching frames on a test student.

6. Revising the contents and sequence and even criterion frames in the light of the reaction of the student to the trial sequence.

7. Drafting the remainder of the teaching frames of the program, trying them out on students from time to time, presenting them for criticism to colleagues, revising objectives and criterion tests as the response of students and colleagues dictate.

8. Assembling the entire program and field testing it.

Again it should be emphasized that the sequence of steps above is not to be viewed as a rigid and unchanging sequence. It is simply a scheme for presenting what a programer approximately did in working on the Programed Instruction Project.

Each of the above steps has obvious connections with what an instructor does as a lecturer, evaluator, discussion leader, tutor. It is possible for a person to teach acceptably for years in traditional fashion without ever being squarely confronted with the assumptions he makes about learning and teaching. Writing a program in the manner described above leads the programer to examine direcly some of the most significant aspects of his teaching processes.

In the following chapter will be found statements made by GLCA faculty members evaluating their experience as programers. These persons prepared programed materials under the sponsorship of the Programed Instruction Project during the Summer of 1964.

Contrast with Earlier Concepts of Programed Instruction

Programed instruction has been subjected to a good deal of misunderstanding, some of it stemming from exaggerated claims made for it in the past by over-zealous practioners, some of it growing out of early rather primitive concepts of the nature of programed instruction and from early exemplars of programed instructional materials, some of it originating in negative attitudes of persons who opposed programed instruction and who failed to become informed about the changes that were occuring in the principles and practices of programing practices of preparing programed materials.

The GLCA Programed Instruction Project makes no claims for the teaching value of programed instructional materials other than those already discussed in Chapter 7.

Experience in producing programed material on the Programed Instruction Project as described in this chapter have caused the programers to move beyond earlier concepts of programing and thereby avoid some of the controversies over what now appear to be irrelevant principles of programing. In order to highlight the present position of the Programed Instruction Project with respect to the principles of programing let us look at the most important earlier concepts briefly, which, (unfortunately still prevent a few persons from perceiving the emerging direction that programed instruction is taking.

Prog

4

Five illustrative principles of programed instruction have been formaulted in an effort to describe what it is and how it works.[29]

1. The student must become actively engaged in responding to the program. The principle suggests that the student should respond often and overtly by writing an answer, selecting a response from several choices, pressing a lever.

2. The student's response should be immediately confirmed. The confirmation is seen as reinforcing the response.

3. The student should not be allowed to respond incorrectly. The principle of immediate reinforcement stated in number two above underscores the importance of the low error rate in a program since it is clearly undesirable to reinforce incorrect responses.

4. The incremental steps must be small. The principle provides the major reason for trying to reduce the error rate in the program. It is assumed by a programer that if a student makes an error on a frame of the program, the frame contained too much information and must be broken up into one or more additional frames, each of which contains less information.

29

---

[29] John Wellens, "Adjunct Auto-Instruction," Technical Training and Industrial Training, Evans Brothers Limited, 1965. Other authors have stressed these five plus variations of them and additional principles as well.

5. The student must be permitted to work through the program at his own pace, again presumably to reduce the error rate by not forcing the student beyond his natural speed of working.

Of these five principles the one that appears to be the most valid is the first one. Active, overt responding, however, appears to be more important for learning perceptions and skills than it does for attaining factual knowledge.

The sample page[30] below illustrates a typical early program prepared in the light of the above five principles. Note how the principles are illustrated in the program.

1. A conductor will carry electric current. A wire or any substance that will carry or conduct an electric current is called a__________________.

conductor.

2. A copper wire will conduct or carry an electric current because copper wire is a good__________________.

conductor

3. A conductor is a substance that will carry or _________ an electric current. Rubber is not a conductor, so rubber will not___________ an ___________________.

conduct
conduct
electric current

4. An insulator will not conduct an electric ________. Rubber is a good _____________ because it will_________________________.
(complete)

current
insulator
not conduct
an electric
current (or)
not conduct
current

5. Electric current can flow or travel along a_______________, but cannot flow along an ____________________________.

conductor
insulator

30.

---

[30] William A. Deterline, An Introduction to Programed Instruction, Englewood Cliffs, N. J.: Prentice Hall, 1962, pp. 17-18.

6. You could receive a "shock" from a copper wire unless the copper wire is surrounded by an ________________.	insulator
7. An insulator is a substance or material that will__________________________. (complete)	not conduct electric current (or) not let current flow (or) stop current
8. A conductor will____________________. (complete)	conduct an electric current (or) carry current

Criticisms of the five principles and the product as described above are not hard to find. The principles have been experimentally tested and none but the first appear to be essential to learning under all conditions of programing. (See Chapter 4). The theory of learning based upon operant conditioning and reinforcement implicit in the principles is open to question on theoretical grounds as an adequate model of human learning. Many experienced teachers felt that the fractionation of the subject matter and the redundancy found in most programs resulting from the principle of reducing student errors was contradicted by the success that they themselves had in presenting large but meaningful pieces of information to students.

From the point of view of this chapter, the five principles are open to criticism for their lack of heuristic value. They fail to illumine the larger problems of teaching. They fail to suggest how a teacher by writing programed material may develop a more sophisticated concept of teaching. No evidence was forthcoming that writing programed materials following the five principles made a significant impact on the teaching effectiveness of the programer as a teacher. In fact, the process of preparing such programs was described as aversive by those engaged in it.

An inordinate amount of attention has been paid in the past to the process of writing frames per se. The drafting of teaching frames become almost an end in itself, and a complicated lore began to develop about how frames should be written. Rather elaborate rules have been established to govern such things as prompting,

Practi

cueing, fading the cues and prompts, practicalframes, copy frames. One of the better books on the subject of frame writing, however is S. Markle's Good Frames and Bad.[31]

As mentioned earlier in the chapter, the Programed Instruction Project paid little heed to the established lore of writing teaching frames, approaching the problem instead from a pragmatic, empirical point of view. One programer mentioned his appreciation that the "very small step approach was not necessary, that fill-in-the-blanks programs are passé." - - Another said that he was glad that no rigid format was prescribed.

Rather than being guided by a set of static principles, the programer focused on what strategies students utilized in attaining knowledge, how the content to be learned could best be presented in the light of the student's learning strategies, how the student could progress toward the educational objectives with the assistance of the program.

It has become clear to those working on the project that programed instruction can better be defined by the process through which programs were prepared than by programs as an end product. Preparing programed instructional materials became a most painstaking and microsopically analytic procedure for doing what most college instructors do extemporaneously in an intuitive way when they develop methods of teaching a course or consider how to deliver a lecture.

---

[31] Susan Markle, Good Frames and Bad, New York: John Wiley, 1964.

Chapter 8

INFORMAL EVALUATION OF PROGRAMING AS A MEANS OF ILLUMINATING TEACHING

INTRODUCTION

On three occasions the impact of preparing programed materials on the teacher was evaluated. The first two evluations occured immediately following the summer workshops in programing in 1964 and in 1965. The third was a more formal quantitative evaluation carried out in the Winter and Spring of 1966. The present chapter will review the results of the informal evaluations. Chapter 9 will contain the report of the formal evaluation. Chapter 8 described the rationale for the preparing programed material and in a theoretical way, its relationship to teaching.

onship
s
ching.

METHOD

In March of 1965 twenty or more persons who had prepared programed material under GLCA sponsorship during the Summer of 1964 were sent a follow-up questionnaire asking them to evaluate their experience in preparing programed material as they looked back on it from the vantage point of nine months. A copy of the questionnaire is shown in the Appendix.

RESULTS

The first question they were asked is the following: State your general evaluation of your programing experience, including the field testing and writing the revisions. The answers to this question were quite varied, but fell roughly into the categories shown below with examples in each category.

1. Programing can be a means to do research on the learning process. One respondent mentioned the necessity for doing research on the learning process itself. Another suggested that all teaching should be oriented to the learning process of students.

2. Programing forces systematic thinking about the teaching process. One programer said that programing was good for saying exactly what he wanted to say. Another mentioned that programing gave him insight into creating detailed materials. Still another said that he was forced to think more systematically about teaching. Another became thoroughly persuaded that the material he had worked on was

2. programable, whereas previously he had wondered whether it was. Still another reported that he became aware of the necessity of careful planning in all areas of teaching.

3. Teachers became more aware of the necessity of formulating course objectives.
One person mentioned that programing helped him set up goals for all his teaching; another seemed to become more conscious of course objectives. Still another put it this way, "What can be tested can be programed." Constructing a program gave another programer a clear sense of what he wanted to accomplish.

A second question asked of the programers is as follows: What new insights or understandings of programing and/or teaching occured to you as result of having constructed and tested a program? The responses of the programers fell into six categories.

1. The value of inductive teaching (teaching by discovery).

   As one programer said, "I was reminded that good teaching in inductive- the student is lead to discovery."

   Another programer mentioned that he discovered in the process of programing how little he wanted to teach; rather he wanted to lead students to discovery.

2. Insight into explicit statement of objectives.

   A programer mentioned that programing reinforced the practice of stating explicitly the objectives of the course, and the means for carrying them out. Another said, "The prerequisite to fruitful discussion is explicit enumeration of goals." A third mentioned that he will plan his course in the future more systematically and efficiently with the objectives more clearly stated. Finally one of the programers reported that, "Some of the goals I had been working toward were worthless!"

3. The value of feedback from students.

   The programer suggested the value of thoughtful student evaluation of the materials. Another said, "Field testing showed me the value of detailed feedback from students." Still another said that programing gave him better understanding of how a student's mind works - - "I would not have known the difficulties had I not tried to program." Still a fourth programer mentioned that he was prompted to reconsider the contact time that he had with students.

OK

4. Student orientation to the learning process.

A programer mentioned that he had learned that a student should answer key questions in the learning process. Another said, "The criterion frames struck me - - a student can tell where he stands."

5. Problems of communication.

One programer reported that the difficulty of communication of terms etcetera was clearly identified in the process of programing. Another programer mentioned that he discovered problems of communication - - that misinterpretations often are not detected until the end of a course in a lecture or even a discussion. Programing identifies them earlier.

A third question was: Looking back over the summer and the school year thus far, what were the effects if any, of programing on your teaching?

1. Application of programing principles to other areas of teaching.

A programer mentioned that he was impressed with the possibility of programing adjunctive material. Another indicated that he had applied linguistic laws to other vocabulary learning in other courses as a result of his programing experience. A third programer reported that he had revised his lab exercises along lines of the linear program. Still another mentioned that he had tried out different use of lecture time. A fifth mentioned that, "... I am more critical about use of class period and testing procedures." Another mentioned an interesting application: In the past he had always lectured by giving the rule of generalization first, and then examples of it. Now he often lectures by giving examples first and then either letting the students discover the rule or giving it to them after the example. In addition, he now holds quizzes during lab periods before going on to the next section. Still another programer reported that he insisted that students develop a reading program around a common theme and is hoping for good results.

2. Insights into the learning-teaching process.

A programer said that he is now more patient with the learning process after having developed a program and tried it out on students. Another indicated that preparing a poor program had made him aware of how concepts can best be put across

across. Still another programer mentioned that writing test frames helped him write exam questions which really distinquish.

Question number four read as follows: What difference if any have your participation in last Summer's project had on the reaction of your colleagues to programed instruction?

The answers to this question followed a one, two, three ratio. The lowest number of responses indicated a sort of grudging consent that was being given by colleagues that programed instruction a was less bad than had been expected. One programer, for example, said his colleagues were less ready to dismiss a programing cursorily. "Some see it as less bad if I am interested." Twice as many responses, however, indicated that the colleagues were still indifferent, had little interest or negligible interest. The highest category indicated cautious but favorable response from colleagues. "My c participation has stirred a latent interest in others." A couple of programers mentioned that there was even considerable interest. One said, "I have been consulted by three faculty members." Another indicated that in the art department other instructors had made use of parts of his program.

The final question was: Judging from your experience, at what point in one's total teaching practice is programing likely to make an impact? This question served as a summary question for the preceding ones.

By far the greatest number of responses indicated that the greater understanding and awareness of the role played by objectives in the educational process was the thing that struck them the most.

Another category of responses indicated that the teacher developed greater appreciation of the learning problems faced by students.

Another category of responses indicated that there was a shift in the teacher's concept of himself as a teacher.

A variety of responses were about specific learnings that had occured to them as programers, and have been summarized earlier.

Responses that were more cautious and even on a negative side were as follows: Programing is not effective as discussion for the interpretation of poems . . . I see the possibilities and the limitations of programing. One person mentioned that the attitude of the instructor toward programing effects the workability of the program.

OK

Evaluation of Programing Experience by 1965 Programers

In the Summer of 1965 a dozen faculty members of Great Lakes colleges prepared programed materials under the sponsorship of the Programed Instruction Project. As in the Summer of 1964, two workshop sessions were set up in which the programers received instruction in the process of writing programs. The description of the training workshops may be found in Chapters 1 and 2.

After each of the two sessions of the 1965 Summer workshops, the programers responded to questionnaires with which the workshop and the experience of preparing programed materials were evaluated. The results of the evaluation of the workshop as such are given in Chapter 2. The following section reports the verbatim answers of the programers to the last three questions of the questionnaire which deal with the general impact of programing rather than the specific evaluation of the workshop.

The questions are:

3. Judging from your experience so far, at what points in your total teaching practice is programing likely to make an impact? For example, is programing likely to effect your setting up objectives for your course, your lecturing method or your concept of yourself as a teacher?

4. What difference, if any, do you think your participation in this summer's project will have in the future on your colleague's reactions to programed instruction?

5. Summarize your general evaluation of your programing experiences thus far.

In the following discussion the term "July questionnaire" refers to the answers given on the first questionnaire dated July 5, 1965. The term "August questionnaire" refers to the answers given on the second questionnaire dated August 9, 1965. Not every programer responded to the questionnaires.

Programer A

3. July questionnaire
I believe that I have assumed clarity of objectives rather than actually clarified them for my students. At least, it seems to me that my objectives in some courses have been too general. I have probably also assumed that my students know how to educate themselves without guidance of a very specific nature. Now I am changing my mind on this matter. I have also been strongly motivated toward the lecture method of teaching as a timesaving factor. Now I am beginning to see more clearly the value of student participation in spite of the time factor.

3. August questionnaire

The first impact in on teaching in general. I am now convinced that programing can play a vital part in education and that it definitely will play that part increasingly well in the future. The second impact has been on me as a teacher. I now make a more concerted effort to establish clear objectives in each of my courses and communicate those objectives to my students. Of course, I had thought that I was doing this, but I fear that often the objectives were clear only in my own mind.

4. July questionnaire

Teachers in departments in general have been anti-program as an instructional method. Practically none would agree that composition itself can be programed. I think perhaps the fact that I am willing to investigate programing and to try my hand at it will erase some of these doubts, at least among my immediate colleagues, and lead the way to a somewhat more openminded consideration of the possibilities of programing on their part.

4. August questionnaire

I can only report that my colleagues who have seen my program and those who plan to field-test it are enthusiastic about programing for the first time. One colleague may stress programed learning in an Institute which he hopes to direct next summer.

5. July questionnaire

I find, I am pleased to say, that I have become deeply interested in the possibilities which programing offers in my field. I have already thought of another subject related to my interests which has not yet been programed. The work this summer, although it has been taxing, has not been a "chore" for me, and I have looked forward to each day's attempt. I had thought that completing the textbook would have been more exciting and more personally rewarding; now I would hesitate to say that. I give most of the credit for this interest to the organization of the first workshop and to the follow-up procedures: visiting editor, outside consultants, provision for test subjects, etc.

5. August questionnaire

I am now enthusiastic about programing and will continue to work in this area. I have a second subject for pro-

OK

graming in mind and hope I can get to it in the near future.

Programer B

3. July questionnaire

The experience of programing is going to make my objectives in all my courses much more specific and precise----which is to say that programing is a process that develops a certain kind of critical sense about the teacher's obligation to the student. The experience is going to mean a more critical use of lecture materials, with a clearer distinction between what the student might best learn for himself with suitable guidance and what he can learn best from an organized lecture.

4. August questionnaire

I really don't know. I hope they will come to see that there is a place for programed instruction because I think it will raise the level at which they can approach other parts of their teaching, and I will be able to show them what they might do, as I would not have been able to do before.

5. July questionnaire

For me it has meant a new approach to an old problem - - - the problem of teaching students how to put words together. It has opened up a method of guidance of which there has been no other form except standing over a student and showing him how to construct his sentences as he wrote them.

Obviously, then, my evaluation is high.

Programer C

3. July questionnaire

Programing fits in with my conception of teaching. The teacher ought to create the conditions wherein learning might take place.

Learning is a personal appropriation. To facilitate this activity teaching should resist the temptation to be personal. The personality of the teacher is a threat to learning. It tempts the student to accommodate to the teacher's personality for the sake of basking in his glory, or for

OK

the sake of marks of approval. Instead, the teaching situation ought to force the student to appropriate the material in his own way. Since the student will try everything to avoid this, the teacher has to outsmart him.

4. July questionnaire

It might cause people to reconsider the cliches they have on programing. Everyone has been ready to dismiss my project out of hand on the assumption that programing is necessarily imcompatible with existentialism. I think they do this on the assumption that programing is for robots, but not for people. Moreoever, there is the implication that people are robots some of the time, so that it is possible to program robot-like learning but not people-like learning.

I go on the assumption that there is no such thing as robot-like learning, i.e., there is no evidence that the robot is an adequate model for programed instruction, and that the possibility of programed instruction in one area opens up the possibility of programed instruction in another.

5. July questionnaire

Programing is always good experience for teachers. It contributes toward clarity in objectives and precision in method.

Programer D

3. July questionnaire

I have come to the conclusion that in logic, my teaching takes too much for granted on the part of students: I have assumed that they would understand without help more than I now suspect they do.

3. August questionnaire

The answers given on the last questionnaire remain unaltered.

4. July questionnaire

Difficult to say. The evidence isn't in.

4. August questionnaire

I don't know yet.

5. July questionnaire

Exciting and stimulating. I've learned a great deal.

5. August questionnaire

Comments on the last evaluation sheet remain unaltered.

Programer E

3. July questionnaire

I will probably be more certain to state objectives and give complete directions for any student participation.

3. August questionnaire

It will make me more conscious of the need to give the students a clearer idea of the content and objectives before beginning work.

4. July questionnaire

I doubt if it will make any difference.

4. August questionnaire

My colleagues are well acquainted with programed instruction, at least half of them having written programs so I doubt if my participation will have much effect.

5. July questionnaire

I am still unconvinced of the value of a programed course of instruction without the personal relation with a teacher and without experimental materials, models or pictures.

5. August questionnaire

I'm still not convinced of the value of straight programed instruction in small schools or colleges. I do believe that a combination of good photographs or other audio-visual aids with the programed instruction would be quite valuable.

Programer F

3. July questionnaire

Neither objectives nor method are changed, but content of

OK

lectures is moved up a notch if they are based on material already covered in programs. Concept of myself as a teacher has been influenced. Separation of the teaching and learning process - or, at least of the "dishing out" vs. "taking in" has resulted in a very strong feeling that programed instructions limitations must be kept in mind. Programed instruction work throws into relief certain attitudes which I have come to suspect. For example: "evaluation" in some respects, is a dangerous preoccupation, I believe.

3. August questionnaire

All three to some extent.

4. July questionnaire

I haven't thought of this point. Can't say. I suppose as it spreads it attracts interest.

4. August questionnaire

I can't predict this. It is possible that the department faculty will like the program and this would, I suppose, interest them in it. The faculty at large is reasonably sympathetic and should be reinforced by the knowledge that things are continuing.

5. July questionnaire

Every attempt has clarified my view of the problems of teaching the material. This has a generally beneficial effect. My program work in the past was about half bad and half good (one useful one not-so-useful program). It is too early to judge this one.

5. August questionnaire

I have a much more hopeful view of this summer's project after early August and I believe that, if I had the time, I would like to round out a complete set of programs for an introductory course but this would take a tremendous lot of released time. I have about half of what is needed, I think.

Programer G

3. July questionnaire

Probably mostly my lecturing method, I have grown to appreciate even more than before the advantages of examples and case studies as learning devices for students.

3. August questionnaire

It will probably cause me to rely further on the "situationist" or "case study" technique in classes - - to cause the student to come to his own conclusions. This would be the EGRUL principle. I have done this in the past but I think I have tended to put the answers in the student's mouths more than I should.

4. July questionnaire

I think they feel that most of my colleagues presently have virtually no idea of what programing is but that they respect the results of programs for that reason. I think they will admire the concept of programing whether they actually do any or not.

4. August questionnaire

This is a very difficult question to answer. I doubt that it will have much impact on my present colleagues because most of them in my department seem to have a fixed negative opinion about programing, feeling especially that it is too much ado about very little.

In terms of friends and colleagues in other departments, I think they have a more positive attitude toward the idea of programing. Knowing that I use a program would not, in my opinion, damage their opinion of the enterprize.

5. July questionnaire

I am generally well satisfied because it has forced me to think and write in terms I assumed were either common knowledge or were easily understandable. It has frustrated me at times because some of my "brain storms" turn out to be more storm than brain. But this is exactly why it is a beneficial experience. It has also been a learning experience and enterprize for me. I find in checking the accuracy of some of my thoughts and statements that I have been careless with my classroom use of certain concepts in the past. The newness of the experience has made it very interesting summer thus far.

Programing H

3. July questionnaire

This experience will have a very definite effect on my teaching, both in setting objectives and in techniques in the classroom.

3. August questionnaire

The two points I expect to be most affected are lecture technique and examination writing. There will be a definite sharpening of objectives but not a very drastic change in content.

4. July questionnaire

Not very much local effect. Both of my colleagues in the department here are already very much interested in programed instruction.

4. August questionnaire

I think this will improve the acceptability of programed instruction locally. However, as I mentioned before, the climate in the department here is already quite favorable. I am hoping to get some people in the department to look over the completed program, too, as some of it is closely related to their field of interest.

5. July questionnaire

This has been a very stimulating thing for me and I am very glad that I entered the project.

5. August questionnaire

This has been very stimulating to me. The developmental testing alone has provided much new "food for thought" on the problems of teaching and learning. The difficulties encountered by the students trying out my program have shown me some large faults in what I had assumed to be acceptable teaching methods. These experiences and the technical information supplied at the two workshops make me feel that I have learned a great deal which will be very useful to me professionally even if I do not develop into a good program writer.

me
that

Programer I

3. July questionnaire

Its strongest impact has been on how I think through a problem and, through that effect, onto my sensitivity to how students may be working on a problem. I'm less eager to "cover" a body of material and more eager to help a student hit his stride in discovering the order and the nature of the material.

3. August questionnaire

Same remarks as in my evaluation of the first workshop.

4. July questionnaire

I think the main thing will be that they'll have a program to look at that is designed with local circumstances in mind. Being more concerned with college than any other place, they may prick up their ears. (On this campus I gather that the chief notion about programing is that it works for factual material and for average-to-slow students but not for associative material or judgment-making and not for fast students).

4. August questionnaire

Same remarks . . .

5. July questionnaire

I've been dismayed at how easy it is to beg the question in organizing the presentation of a body of information and delighted to see how students respond to a mode of analysis that programming demonstrates very effectively. On the one hand I find it hard to be clear and to arrange for an "organic" development through a batch of material, on the other hand I'm putoff by how slow and repetitious have been the three or four published programs I've worked on. I'm becoming interested especially in the next step after programming - - a step toward identifying students' modes of working and then helping them capitalize on their mode as well as practice "alien" modes.

5. August questionnaire

Same remarks . . . .

OK

Programer J

3. July questionnaire

   It is likely to be most helpful in the learning of basic concepts and skills. I believe I can be more certain of accomplishing these kinds of learning through the use of programmed material and also cover more material. These kinds of materials will not have to be dealt with in lectures in laboratories and will thus free the teacher for "creative" type of teaching.

4. August questionnaire

   I suppose it will help them to accept programmed instruction. This will depend greatly on the success of the program developed.

5. July questionnaire

   My feeling that programing would take considerable thought, skill, and time has been reinforced, but I have not experienced any great frustrations yet. The programming experience has emphasized the need for operationally defined objectives; the need and advantages inherent in intergrating material that the student formerly got from lectures, books, labs, etc.; and perhaps also the advantages of more active and stronger learning situations.

DISCUSSION

Testimonial evidence indicates that the programers see the following ways whereby programing can apply to broader problems of teaching: Programing can be a means of doing research on the learning process; programing forces systematic thinking about the teaching process; teachers become more aware of the necessity of formulating course objectives; the value of teaching by discovery is highlighted, as well as the value of stating objectives explicitly; programers see the value of getting feedback from students and to consider the student orientation to the learning process; problems of communication were highlighted.

CONCLUSIONS AND IMPLICATIONS

There is sufficient testimonial evidence of the value of preparing programed material for the insights gained there from into other aspects of teaching. More systematic study needs to be made of the nature and extent of these insights. The following chapter reports such a study.

Chapter 9

FORMAL EVALUATION OF PROGRAMING AS A MEANS OF ILLUMINATING TEACHING

INTRODUCTION

In Chapter 7 we described the process of training programers and of preparing programed instructional materials. Programers were trained to formulate objectives in observable, testable terms, to write criterion test items that validly and reliably assess the students progress toward the objectives, to select the contents of the program in terms of the objectives, etc. From the very first training workshop many programers perceived relationships between the principles and techniques of preparing programed materials on the one hand and many broader educational procedures used by college teachers on the other. Chapter 8 records some of the insights that programers gained into the relationship between programing and teaching.

Such testimonial evidence as recorded in Chapter 8 may be sufficient to convince many persons that preparing programed materials is a process that clarifies many other phases of teaching not directly related to programing. However, testimonial evidence is subject to many well known criticisms most important of which is that there is no control group with whose statements the testimonies of the programers can be compared. Without a comparable control group it is impossible to tell whether the insights expressed by programers are any different from insights that any other college teachers might express about teaching.

Statement of the Problem

If the preparation of programed instructional materials is to serve in the future as a device for preservice or inservice education for teachers it seems desirable to establish its relationship to other selected aspects of teaching on as firm a research base as possible. That is, the positive benefits of preparing programed materials needs to have something more solid than testimonial evidence as its foundation.

The general problem with which this study was concerned is that of exploring the relationship between selected aspects of an instructor's concept of teaching and the principles and techniques he learned in the process of preparing programed instructional materials. In more general terms the problem is that of finding

---

* Written in collaboration with Clarence Tauba

out the changes which develop in one's theory of teaching out of the process of programing. Some of the specific questions dealing with this problem are as follows:

1. Does preparing programed materials influence one's concept of teaching.

2. Is it possible to formulate assumptions and questions about selected aspects of teaching which and questions differentiate programers from non-programers?

3. Using the assumptions as criteria can independent judges reliably differentiate statements about selected aspects of teaching made by programers from statements made by non-programers?

4. Specifically, what assumptions and questions differentiate a programer from a non-programer and which assumptions and questions held by a non-programer differentiate a non-programer from a programer?

Assumptions about Selected Aspects of Teaching

The following critical assumptions about the selected aspects of teaching were utilized as guides both in the construction of questions that made up the interview used in this study, and in constructing the criteria whereby the judges rated the answers given by the respondents in the interviews. (See Appendix F-1 for a copy of the interview schedule) The statements of the assumptions given below are not necessarily systematic, definitive or polished. They are presented here, however, verbatim and unedited so that the reader can judge for himself the adequacy of these assumptions as they were actually used in the study:

1. In preparing programed instructional materials the *methods* of instruction have more value relative to *content* than is usually ascribed to them by college instructors. The importance of teaching *methods* as compared with *content* increases in the estimation of the instructor who has prepared programed material; he pays increasing attention to and shows increased interest in teaching methods. (Used as basis for interview question two.)

2. Formulating objectives in explicity, behavioral, objective, operational terms (in terms of outcomes of student behaviors) is a cardinal principle of programing. After having been trained in the principles and practices of programing and having prepared programed material, the programers will move in the direction of expressing a need to formulate general teaching objectives as described above. (Used as basis for interview question four.)

3. An important principle of programing is that students should be tested in terms of progress in attaining the objectives of the program (this is the ranking function of tests). After having been trained in the principles of programing and having prepared programed materials, the programer will move in the direction of developing tests and measuring student progress in relationship to teaching objectives. (Used as basis for interview question five.)

4. Analysis of materials to be programed is related to and grows out of the objectives of the program, and material to be programed is to be organized empirically and pragmatically in terms of the students ability to deal with it. The programer is to be guided by feedback from the students; the programer is not to assume that students see all the relationships, meanings, etc., but will check to see if they actually do; the programer will be concerned about the amount of information presented in each step of the program, the relationship of one step to the other, and the relationship of concepts and theories within his program. A programer will relate objectives, get feedback from students, and relate materials within a course. (Used as basis for interview question six.)

5. As a result of having been trained in the principles and techniques of programing and having prepared a program, the programer will be more inclined to test students' specific knowledge of the material to be taught prior to the students' starting a course and to reorganize the content and methods of a course in the light of what he discovers about students' previous knowledge. (Used as basis for interview question seven.)

6. Students need to be actively and responsively engaged in learning; their activity improves not only their learning, but also provides feedback to the programer about the strengths and weaknesses of his program. A programer, therefore, will realize the importance of developing an open searching atmosphere in the classroom, encouraging active participation in learning and discovery, and a questioning attitude on the part of the students. (Used as basis for interview question eight.)

7. The material itself must be made intrinsically motivating, since the programer cannot count mainly on interpersonal relationships with students to motivate them. Motivation in programing comes from the challenge of discovery, the freshness of the approach to the material, the encouragement that comes from successfully solving problems. After

having been trained in the principles of programing and having prepared a program, the programer will move in the direction of motivating students by the way in which he presents the material. (Used as basis for interview question nine.)

8. The purpose of testing students is not only to evaluate the progress of students toward the objectives of the program, but also to give the teacher data with which to revise his assumptions about students' knowledge, the level or difficulty of the content, and the sequence of the material (this is the feedback function of testing used in the evaluation of teaching). Testing should be frequent, and the results immediately fed back to students. After having been trained in the principles and techniques of programing, the programer will move in the direction of incorporating the above principles in his regular teaching procedures. (Used as basis for interview question ten.)

9. After having been trained in programing principles and having prepared a program, the programer will be 1) more likely to use new instructional media in his teaching, 2) favorably disposed toward their use, 3) know how to use them discriminatingly, and 4) be informed about them. (Used as basis for interview question 11.)

10. To summarize, it is assumed that programers will do the following: (The summary was used as a basis for interview questions one, three and 12)

    1) Pay increasingly more attention to methods of teaching.

    2) Formulate objectives explicitly in operational behavioral terms.

    3) Evaluate students' progress with greater regard to course objectives.

    4) When organizing and analyzing course content, will do so in relationship to objectives, will get feedback on adequacy of organization from students, will not assume that students understand material, but will find out empirically.

    5) Find out what students know about specific material in a course before teaching it to them.

    6) Get active participation from the student in learning, develop an open searching classroom atmosphere, and obtaining feedback from them.

7) Develop materials and content that motivate students because of the challenge of the discovery they contain, because of the motivation they get through successfully solving problems, through the freshness of the approach, and the pacing of the material.

8) Assess students frequently not only to evaluate their progress toward the objectives, but also to find out where the course needs improvement.

9) Develop favorable attitude toward, and more frequent use of, new instructional media.

METHOD

The following procedures were used in conducting the study:

Subjects

A total of 24 subjects were used in the study. Twelve GLCA instructors who were trained and who prepared programed instructional materials under the aegis of the Project during the summer of 1965 and twelve members of a control group. The programers will be called the experimental group.

Ideally, the experimental group and the control group would have been randomly selected from a common pool of persons who applied to prepare programed materials. Since, however, such a procedure was manifestly impossible to follow under the conditions of the Project, the next best step was to ask the academic dean to select persons comparable to the experimental group to serve as a control.

In forming the control group of twelve members the Director asked the academic dean of each college from which the 1965 programers came to match each 1965 programer with a colleague who would serve as his control. The Director provided each dean with a list of criteria for the selection of control faculty members. The criteria were as follows:

1. The control person should come from the same general academic area as the programer; for example, from natural science, humanities, modern foreign language, or social science. He need not, however, necessarily be from the same department.
2. The control should have approximately the same general level of interest in teaching and similar willingness or unwillingness to try out new educational methods.

3. The control should have approximately the same general level of teaching ability.

4. The control should have approximately comparable experience as a college teacher.

5. The control should have no experience in preparing programed instructional materials.

Research or counseling skills, however, were specifically excluded as criteria for the selection of the control group. Selection was to be made entirely on the basis of teaching skills and interests.

Procedures

Ideally a research design using pre and post measurements and experimental and control groups would have been employed. Although experimental and control groups were used, various circumstances prevented the use of pre-measurements. The most important circumstance was a lack of a set of assumptions about teaching prior to the beginning of the summer of 1965. Furthermore, an adequate interview instrument for obtaining the statements of programers and non-programers with respect to the assumption was lacking.

For purposes of this research it was assumed that prior to the summer of 1965 both programers and controls had comparable conceptions of teaching and that any differences that were to be found between their concepts of teaching following the summer of 1965 were due to the training that the programers received and the experiences they had in preparing programed instructional materials during the summer of 1965.

Variables

It is assumed that the independent variable in this research was the training and the experience of preparing programed materials and field testing them as described in Chapters 2 and 7. However, in as complex a situation as this project presents it was impossible to control or even recognize all the variables that might have been operating. The training workshops consisted of two three-day workshops held three weeks apart, the first in June and the second in July, and the additional seven weeks of programing which for most of the programers extended into the fall of 1965. It should be noted that there was a minimum of discussion about the relationship between programed instruction and teaching during the summer of 1965. No systematic effort was made to help the programers perceive what these relationships were. This experience of preparing programed materials differs from the assumed random activities of the control group during the summer of 1965.

The set of statements made by programers and non-programers in an hour-and-a-half long interview conducted by Dr. Clarence Leuba, former chairman, Department of Psychology, Antioch College served as the dependent variable. The interview schedule is given in Appendix F-1. The interviewer did not know until the end of the interview who was an experimental and who was a control subject, except in two instances where he was familiar with the campus situation.

Method of Collecting Data--Interview Procedures

After the deans had notified the Director of their selection of control persons the dean was asked to write a letter to each prospective control group member asking him whether he would be willing to be interviewed by Dr. Clarence Leuba on "some selected aspects of the total process of teaching as a part of the overall Programed Instruction Project". The controls as well as the experimental group were paid $25.00 each for being interviewed. After they received the letter from the dean and all had indicated their willingness to be interviewed Dr. Leuba made appointments with them to carry out the interviews. These were conducted from six to nine months after the workshops during the months of January, February, and March, 1966.

The interviewer, after making the necessary appointments, spent a day or two on each campus interviewing everyone who was either an experimental or control person. The interviewer tape recorded each of the interviews and also wrote down the pertinent aspects of the responses verbatim. When the interviewee had finished his answer to a question the interviewer read what he had written to the interviewee who then agreed to what had been written or made additions or changes to it.

In addition to the twelve questions on the interview schedule the interviewer also asked a thirteenth question aimed directly at the programing background of the respondents and at their opinions regarding the degree of applicability of programing principles and procedures to the development of other educational materials. The responses to this question were treated separately from the responses to the first twelve questions.

An interview procedure was selected in favor of a questionnaire approach because it was deemed necessary to allow the respondents as much latitude as possible in giving their answers to the questions in the interview schedule. Multiple choice questions or a check list would have been unduly restricting. To have the subjects, however, write out their answers to a questionnaire would have precluded further questioning for purposes of clarification.

Processing the Interviews

The interviewer conducted a total of 27 interviews: 12 experimental, 12 control, and 3 practice interviews. The responses to the interview questions as recorded verbatim by the interviewer were sent to the project office where the answer of each respondent to each question was typed on a separate page of which multiple copies were made. In its final typed form each interview consisted of twelve pages, each page containing one of the twelve questions of the interview and the answer given by the respondent. Each respondent was assigned a code number. His code number was stamped on the back inside margin of each of the twelve sheets on which his answers were typed. The code number was so placed that when the answer sheets were punched and placed in a binder the code number was completely hidden underneath the binder.

The answer sheets of the respondents in their final typed form were disassembled and sorted into twelve piles, each pile containing the answers to one of the interview questions. Pile number one contained all of the answer sheets from the twenty four respondents to question number one; pile number two contained the twenty four answers to question number two, _etc_. The answer pages to each question were then shuffled into random order, reassembled, and bound one set of answers in each binder. The judges who were to rate the interviews were prevented by the random ordering of the answer pages from falling inadvertently into a rhythm or set pattern of rating the answers. In summary, at the time the judges rated the 24 interviews they were contained within twelve binders, each binder containing twenty-four randomized sheets on which were typed the answers of the experimental and control groups to the twelve questions that were asked in the interview.

Rating the Respondents Answers

Three judges were selected to rate the responses of the interviewees to the interview questions. The judges were Dr. Leslie Beach, Department of Psychology, Hope College; Mr. James Brink and Mr. Roger Scott, Graduate Assistants, Center for Research on Learning and Teaching, University of Michigan. Each of the judges, familiar with principles of programing and experienced in teaching, was given two full days of training by the Director. The first day of training consisted of going over the assumptions that were to serve as the criteria for rating the answers to the interview questions. At that time, the final rating scale was described and made final. One of Dr. Leuba's practice interviews was used to illustrate how the material was to be rated.

In the second training session, the three judges were brought together and were given practice in rating the remaining two practice interviews. The attempt was made to get as high agreement among the judges as possible during this training session. Whenever disagreements occured the reasons for the disagreements were identified and clarifications were made in the procedures for rating the answers.

The interviews were rated in two stages. The first stage consisted of a sentence-by-sentence, phrase-by-phrase, and word-by-word analysis of the answer to a given question in terms of the extent to which the answer agreed with or ran counter to the principles of programing expressed in the assumption underlying the question under consideration. The judges were instructed to encircle key phrases, to mark words, underline sentences, use pluses and minuses and numbers ranging from +3 to -3 to give a first rough rating to the respondents answer. As a guide to their rough analysis they were asked to use the seven point scale given below:

-3	-2	-1	0	+1	+2	+3
Generalization plus examples	Specific Operational examples	Generalities, no "why"	Irrelevant	Generalities, no "why"	Specific Operational examples	Generalization plus examples

If, for example, a respondent's statement, was irrelevant to the assumption it was encircled and marked zero; if an answer contained a specific operational example of the assumption the example was circled or underlined and marked plus two. When the first stage of rating was completed the judge had annotated, underscored, and sprinkled the answer sheet with negative and positive numbers.

The second stage of judging the interviews consisted of giving a final rating to the respondent's answers. The judges were given the following instructions:

> After you have marked the statements, sentences, and words in the answer book according to the seven point scale above combine your scores and give a final global rating to the answer on the five point scale below, using the following rating:
>
> Rating: In the light of the evidence found in the answer to what extent does the respondent show that he is aware of the assumption, principles, and techniques of programing that are relevant to the situation described in the question?

1	2	3	4	5
Evidence of lack of awareness of principles	Little or no awareness/balances between awareness and lack of it	Some awareness of principles	Considerable awareness of principles	Thorough and explicit awareness of principles

No formalized rule was used to combine the pluses and minuses and numbers from the first stage in making the final global rating. The first stage served as a device to insure careful reading by the judge rather than as a process of unitizing or systematically weighting the various parts of the respondents' answers.

The judges were asked to rate all the twenty four respondents' answers to one question in one sitting. After completing the first stage they were to make a tentative final rating to each of the answers and then to review and confirm their final rating. They wrote their final rating from the range of 1 through 5 on each of the answer sheets in the answer booklets and initialed their rating as confirmation. The judges completed their rating in about three weeks.

The judges returned the twelve answer booklets to the Director with their ratings to each answer. The Director reassembled the interview questions so that the answers to all twelve questions by one respondent were put back into one folder. The judges ratings were then tabulated by judge, question, and respondent. (See Appendix F-2)

RESULTS

The statistically significant amount of agreement was found among the judges as determined by Kendall's coefficient of concordance, W,= 0.908. Average intercorrelation among judges $\bar{R}$= 0.862 ($p < .001$). (See Appendix F-3.)

The difference between programers and non-programers on the x test was found to be significant ($p < .05$). (See Appendix F-4). Difference between programers and uninformal controls* was significant ($p < .01$) as determined by the Mann-Whitney test. (See Appendix F-5).

---

*Dr. Leuben discovered that half the control group was relatively well informed about programed instruction, the other half was not. For purposes of some analyses the former group is called the informed controls (CI) and the latter group is called (CU). See section in "Results from Qualitatives Evaluation".

The point biserial correlation between matched pairs, one programer and one control person, rpb= 0.566 ($p < .05$). Since the *a priori* assumption was that programers would be superior, the difference is significant. (See Appendix F-6).

The interview questions were rank-ordered on the basis of their power to discriminate between programers and non-programers. See Appendix F-7 for the statistical procedures for finding the ranks. Below are the interview questions by number, the assumptions by number on which questions are based and which the judges used in ranking the respondents' answers, the rank order of each question in terms of its discriminability, power to differentiate programers from non-programers, and a summary statement of the question. The significance of the differences of the ranks of each question was not obtained.

Interview Question	Assumption	Rank order	Summary of Question
11	9	1	Use of new media
2	1	2	Content vs. method
12	10	3	Recent changes in thinking
6	4	4	Analysis and organization of course
3	10	5	Role of the teacher
8	6	6	Teacher-student relationship
1	10	7	Next steps in development of teaching
9	7	8	Sources of student motivation
4	2	9	Formulation of objectives
5	3	10	Student evaluation
10	8	11	Frequency of evaluation
7	5	12	Evaluating students previous knowledge

Results from Qualitative Evaluation

The interviewer collected data from which further qualitative evaluation of the impact of programing can be made in addition to the results described above and in Chapter 8. He did this by asking a thirteenth question, the answer to which was not recorded on the tape recorder nor given to the judges to rate along with the other twelve. Until he heard the answer to the last question, number 13, the interviewer was not aware of who was the control and who was the experimental person, except in a couple of cases where he knew the campus situation. This question was aimed directly at the programing background of the respondents and at their opinions regarding the degree of applicability of programing principles and procedures to the development of other educational materials.

> Question 13 had three parts, (a), (b), and (c) as follows: Part (a) Do you happen to be familiar with the methods used in the development of programed instruction? To this part, the 12 programers all obviously answered "yes".
>
> Part (b) If yes, do you feel that the principles and techniques involved in the preparation of programed instruction have - or do not have - application to other methods of instruction? In other words, are the principles and techniques of programing applicable only to preparing programs or do they have broader applicability in education? All the programers without exception, saw broad applicability in education; and in most cases, they were very emphatic and certain about this; the answers came quickly and without hesitation. Typical answers were: "In all forms of teaching"; "Extremely useful" "Wide (or broad) applicability"; "They - the principles of programing - are based on sound psychological (or educational) principles"; I became more aware of their general appicability".
>
> Part (c) Just how are they applicable? To what specific methods of teaching?

The following were the most commonly mentioned applications; with the exception of the last one, each was mentioned by half or more of the respondents.

1. Getting regular and frequent feedback from students regarding what is difficult or unclear, checking on the assumptions and presuppositions they as teachers had been making regarding what students already know, what interpretations students make, what students understand or do not understand, how students learn, what conclusions students are drawing as from lectures or reading; and revising educational materials in the light of the informal questioning of students and of formal testing. It was not until they had gone through the rigorous and repeated testing of their educational materials by getting students' reactions as required in the preparation of programed material, that most instructors began to fully realize the importance of this frequent and regular feedback from students.

2. Not skipping any essential steps in problem solving and in the development of knowledge in general; proceeding by steps of appropriate size and in the proper sequence, no matter whether the

overall approach was a chronological, historical, or purely logical one.

3. Stating objectives in clear, specific, objective, behavioral terms; and not in just vague, general ones, like "a better appreciation by students of my area"; stating objectives in such a way that students can be tested regarding the extent to which the objectives have been achieved.

4. Being more critical and more precise in the development and use of instructional materials; requiring more discipline, thoroughness, and clarity from oneself and being more careful in the organization of educational presentations; thinking about how one teaches as well as about the content of one's teaching.

5. Enabling students to find out at once whether their - the students' - knowledge was correct or incorrect and whether their understandings were adequate or not. This implies the necessity of frequently questioning and testing student knowledge and understandings; and giving them immediately the results of these evaluations; this motivates learning and prevents students from persisting in error.

It is worth noting that none of the 12 programers mentioned one of the procedures previously considered basic in the development of programed instruction; namely, reinforcing the student with the correct answer. The GLCA programers apparently did not feel that giving correct answers indefinitely would continue to furnish students with adequate reinforcement. In fact, they seemed to consider such a procedure boring and an unfortunate aspect of much current programed instruction at the college level. What apparently did impress the workshop participants favorably was the importance of (1) finding out precisely what students didn't know or didn't understand and (2) of quickly bringing this lack to the attention of students. What was undesirable was not necessarily student errors, but the instructor's failure to know about them and to use them either to motivate learning, or to revise educational materials.

The thirteenth question uncovered an interesting finding about the control group. There had been such effective publicizing of programed instruction among the GLCA colleges that, in several of them, the members of the control group turned out to be less naive regarding programing than had been hoped. Though none of the members of the control group had attended the GLCA summer workshop on programing or had experience with the development of programs of their own, half of them indicated, in answering the last interview question, that they were either somewhat or quite familiar with programing; some had even used programed instructional materials. The other half was only slightly, vaguely, or not at all

E

Informed

informed. The control group was consequently divided into the Informed Controls (C-I) and the Uninformed Controls (C-U) each containing six subjects. (See Appendix F-2.)

Like the programers, the informed members of the control group were unanimous in their opinion that the principles and techniques involved in the preparation of programed instruction had applications to other methods of instruction and generally broad applicability in education. They were less emphatic and definite, however; and usually did not see as many applications. They made such statements as "My impression is that there is general applicability"; "I see some possibilities of applications"; "I'm not sure, but I think there are applications".

As might be expected, the six relatively uninformed members of the control group failed to see any applications.

DISCUSSION

The statistical analysis of the judges ratings of the interview data and the testimonials from the programers themselves compared with the controls strongly suggests the conclusion that preparing programed materials does influence one's concept of teaching in the direction outlined in the assumptions. This is a change in educational ideas and teaching behavior in so far as talking is behavioral.

The 18 faculty members (the 12 members of the summer workshop and the six Informed Controls) were unanimous in their opinions that the principles and techniques of programing are applicable and useful in many aspects of college teaching. The 12 respondents who had taken part in the summer workshop, and had actual experience in the development of programs of their own, were more emphatic and certain in this opinion and seemed to see applications more clearly, specifically and extensively. In short, the closer one is to programing the more clearly he sees carryover to other areas of teaching. The first question in the section on the "Statement of the Problem" can therefore be answered in the affirmative.

2

The statistical analysis indicates that the three judges agreed on their rating of the statements made by respondents in answer to the questions of the interview. Thus, the method of interview and rating the interviews is a reliable method, and the third question - can judges reliably rate answers under the section, "Statement of the Problem" can be answered in the affirmative.

It is now possible to answer the second question raised in the statement of the problem in the affirmative. That is, it was possible to formulate a number of assumptions and from them ask questions about teaching. The answers to the questions when rated by independent judges using the assumptions distinguish programers from non-programers. The content of the assumptions defines the way in which the concept of teaching of instructors who have prepared programed materials differs from the concept of instructors who have not prepared programed materials. Faculty members who have had experience in the development of programed material incorporate more of the assumptions into their talking about teaching than do those who have not. Faculty members who have had experience in the development of programed material feel that such experience has a broad educational applicability and the expression of their general educational thinking shows the impact of this experience. Thus, we can conclude that the preparation of programed instructional material does indeed seem to have a broad, educational impact.

ind,

In addition to the significant differences found between the programers and their controls, the significantly high point biserial correlation coefficient indicates that there is an orderliness: It can be assured that good teachers in the programing group were matched by the deans with good teachers in the controls, and poor ones with their counterparts. The difference between the groups was probably not due to their initial teaching ability, but they gained insight about teaching processes as a function of being involved in programing.

In the "Statement of the Problem" the question was raised of which assumptions and interview questions served to differentiate most clearly the programers from non-programers. The question can be answered. Interview questions 11, 2, 12, and 6 (based respectively on assumptions 9, 1, 10, and 4) most clearly differentiated programers from non-programers. In accord with the findings of Lysaught reported earlier in Chapter 7, the question dealing with the use of new media ranked number one. The preparation of programed material favorably disposed the programer relative to the non-programers, to the use of new media; and perhaps inclined him to use them, to use them discriminatingly, and to be informed about them.

Second in order of discriminating power was the question of the importance of method versus content in teaching. Programers placed a greater value on teaching method relative to content than did non-programers. Third in rank in disciminating power was the question 12 asking for recent changes in their thinking. The answers of the programers indicated that many of the answers given to the earlier questions in the interview represented recent changes in their thinking. This does not mean, of course, that the control group was not thinking about teaching nor that the thinking of its members was not in the process of changing, but rather that thinking of the non-programers along the lines outlined in the assumptions and questions had not changed as significantly as had that of the programers.

The question that stood fourth in rank in discriminating power was number six, dealing with the analysis and organization of the course content. Although the assumption on which this question is based is complex, the interpretation can tentatively be made that the analysis of the course content in terms of previously stated objectives and the empirical testing of the sequence of the content on students in order to obtain feedback from them are the major learnings obtained by the programers in contrast to the non-programers.

It is noteworthy that interview question number four dealing with the importance of formulating objectives explicitly, behaviorally, objectively and in operational terms was ranked only ninth in its power to discriminate between programers, and non-programers in view of the low rank given to the question about objectives, particularly in comparison to the relatively high rank given to the question six about the analysis and organization of course material, it becomes necessary to modify a statement made in Chapter 7, in which it was asserted that, "...it still remains true that no step in the entire process of writing programed material made a greater impact upon the programer's understanding of teaching than learning how to formulate specific verifiable objectives." The data from the study indicate that the analysis and empirical organization of the course material as required by programing made a greater impact on the programers six months after programing than did the formulation of objectives. The higher value of obtaining feedback in organizing the content relative to the value of formulating objectives tends to be emphasized as well in the answers to question 13 reported in the section on results.

It is also noteworthy that on question number 7, dealing with the evaluation of students' previous knowledge, the non-programers responded more in line with the objectives than did the programers.

A word of caution should be added. Sheldon C. Reed, speaking of research on genetic or environmental effect upon intelligence states, "...we should perhaps think of our data as being more erroneous than our speculation, if one may entertain such an unorthdox idea. Clearly, the worst error possible in this area of study is to be certain of our data."[27] Such sentiments also apply to the study reported herein.

A second word of caution should be added. Does programing procedure produce actual changes in the classroom teaching method?

---

[27] Sheldon C. Reed, "The Evolution of Human Intelligence: Some Reasons Why It Should Be a Continuous Process", Am. Sc. September, 1965, P. 321.

We will venture the opinion that the long run impact on the actual education procedures and classroom behavior of most of these faculty members may be slight or even negligible; at least unless there is systematic following by way of encouragement and guidance and freed time for the actual application of the educational procedures and principles which these faculty members now feel can contribute so much to more effective college teaching. Long established educational ideas and practices are not necessarily effectively changed by a few months of practice and a couple of workshops useful as these may be. One of the main weaknesses - often a fatal one - in programs for educational innovation is a failure to follow through over a long enough period of time.

It remains to be seen just how much of this very time consuming experience with the actual development of programed instruction of one's own is really necessary for the carry over or transfer of the more useful programing principles and techniques to other types of instruction. Maybe, practice in the preparation of parts of a few sample programs might suffice, and the time thus saved could be used in the application of programing principles to the instructional methods most used by an instructor, such as in the preparation of his lectures, syllabi, or examinations.

CONCLUSIONS AND IMPLICATIONS

This pilot study strongly suggests that preparing programed materials holds promise as a significant procedure for analysing and improving some important aspects of teaching, especially those having to do with the predesigning of learning conditions. But the door has just been opened. Many large areas of the total teaching-learning process remain to be investigated and developed via the preparation of programed instructional materials.

Further sustained and more rigorously controlled research needs to be conducted to ascertain which aspects of teaching are most influenced by programing and to ascertain the point of diminishing returns, that is, the point at which further programing fails to produce new insights into teaching. What needs to be done to help teachers translate and generalize their new insights to their actual classroom behavior is still open for further investigation. Such research will help determine the future role of preparing programed instructional materials in the total pre-service and in-service education of teachers.

PART IV SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

CHAPTER 10

SUMMARY, CONCLUSIONS AND IMPLICATIONS FOR FURTHER RESEARCH AND DEVELOPMENT

Review of Purposes of the Project

The purposes of the Project as outlined in the preface are grouped below into five categories:

1. To develop programed instructional materials.
2. To evaluate and compare uses of programed instructional materials prepared in 1964 and thereby to discover where programed instruction fits into the curriculum.
3. To evaluate existing commercial programs.
4. To promote basic research in instruction; to evaluate the broader effects of programed instruction; to compare individual versus team preparation of programed instructional material, and to ascertain if evaluating programed instructional material has greater effect on instructional processes than does preparing programed instructional materials.
5. Dissemination of results.

Summary of Project Activities

All GLCA colleges participated in the three-year Programed Instruction Project and were kept in touch with the various activities of the Project through the Director who communicated with a Liaison person on each campus. The Liaison Committee met a total of five times. The Director described the Project to the faculties of all the colleges and made numerous contacts with faculty members on the various campuses for a variety of purposes related to the project. Two major all-Association conferences were held. The first was a series of winter work conferences held early in the life of the Project to introduce the colleges to Programed Instruction, the second was a Final Reporting Conference in which the results of the Project were disseminated to all the colleges.

Results

With respect to the first objective: 36 programs were produced in the two summers of the project. They were field tested in GLCA and other colleges. The programs are all relatively short, topical programs. Each college has received a sample of all the programs that were submitted to the Director's office. Eight programs are currently being commercially published and probably several more will be published in the future.

With respect to the second objective, five GLCA produced programs in the fields of science, social sciences, and humanities were rigorously and systematically evaluated under a variety of conditions in 8 GLCA colleges, by 26 faculty members involving approximately 1200 students. The evaluation attempted to ascertain whether programs teach as well as other conventional instructional methods, whether they are best used before or after classroom discussion of the given material, whether they are used most effectively with lecture or with question and answer discussion and the effects of motivation on students' learning by means of programs. Characteristics of students evaluations and faculty evaluations were also obtained. The programs taught as well or better than traditional methods of teaching; the students and instructors evaluated the program positively.

With respect to the third objective a dozen commercial programs were evaluated. The results were largely inconclusive.

With respect to the fourth objective the impact of preparing programed materials on the programers concept of teaching was investigated. Programing sheds light on other aspects of teaching. In addition the evaluation of the GLCA produced program described above also served to meet objective number 4.

With respect to the fifth objective; 42 programers were supported by the Project and were intensively trained in the principles and procedures of programing. Six editors received further intensive training to consult with the programers. An estimated 200 (about 15% of the total GLCA faculties) were directly involved in the project through conferences, preparing programs, field testing programs, evaluating them, and through contacts with the Director. All faculty members were alerted in varying degress to new media of instruction through the initial round of faculty meetings, and two rounds of visits to display programs. At one point about 70 programs were in use in GLCA colleges, mostly in mathematics and the natural sciences. The results of the project were reported out at a Final Reporting Conference in Columbus, Ohio on April 29, 1966. Eight institutions and agencies other than GLCA colleges were involved in the Final Reporting Conference.

Conclusions

1. Professors in GLCA colleges can prepare high quality programs. But preparing quality programs is a very time consuming process.

2. Programs can teach successfully in all three major areas of the curriculum--science, social science, humanities. The evaluation of the given GLCA produced programs indicated that the programs taught at least as well and in some cases better than traditional methods of lectures, question and answer periods, textbooks with which the programs were prepared. It made little difference whether the program was used before or after classroom presentation and discussion of the material or whether lecture or discussion followed the use of the programed material. Students reacted favorably to the programs they used. Faculty members evaluated the programs they used positively. It can be concluded that good, short, single-topic programs used over relatively short periods of time - two weeks to a month - are effective teaching devices and offer a way of making college teaching more varied and flexible.

3. Results of the evaluation of commercial programs were less conclusive and less consistently positive than the evaluation of GLCA produced programs. The inconclusiveness of the results were due in part to the looseness of the evaluation design. Where good commercial programs were evaluated under somewhat similar conditions to the evaluation of GLCA programs rather comparable results were obtained. The same conclusion probably holds for good commercial programs as for GLCA programs.

4. Preparing programed materials holds promise as a significant procedure for analyzing and improving some aspects of teaching, such as, formulating operational objectives, analyzing subject matter, testing. The more closely involved faculty members became in the process of producing programed materials the more unanimous and emphatic they were in their conviction that there were broad and useful applications of the principles and techniques of programing to other aspects of teaching. In addition, faculty members who evaluated programed materials became more favorably impressed with programed materials in the process but did not necessarily gain the insights into the process of teaching that those who prepared programed materials did. It can be concluded that preparing programed instructional materials sheds lights on otherwise unexamined aspects of teaching.

Many large areas of the total teaching-learning process still remain to be investigated and developed. Sufficient interest, however, has been generated in the process of teaching and the investigation of learning to warrant a full scale attempt to understand them better.

5. The Project demonstrated the value of having an association of colleges prepare and evaluate programs, and the feasibility of a cooperative project demanding a high level of coordination, and possibility of disseminating information on instructional matters. The Project focused the growing interest of college teachers on the process as well as the content of teaching. It can be concluded that GLCA faculties can successfully undertake projects demanding a high level of cooperation.

Implications for Further Research and Development

The following statements seem warranted in the light of the experience on this project.

1. From the value received both from the process of writing programed materials and from the product of the programs themselves it is recommended that college teachers in general and GLCA instructors in particular continue to be trained to write programs and to prepare programed materials as described in this report.

2. Programed materials as prepared on this project are mere forerunners of much more sophisticated programs of the future. It is recommended that means be provided for the exploration of writing and preparing programs to be used in computer assisted instruction.

3. A valuable by-product of the project was the light shed upon the teaching-learning process, both in the process of writing programed materials and evaluating them. It is recommended that the project continue to investigate the process of teaching and learning with a greater emphasis upon learning and with the preparation and use of programed instructional materials and programs for computer assisted instruction as research tools.

Appendix A-1

SCHEDULE AND NUMBER OF CONTACTS WITH FACULTY OF EACH CAMPUS

Dates of Visit	College	# Faculty Contacts
October 28, 29, 1963	Hope	4
November 4, 5, 1963	Ohio Wesleyan	12
November 11, 12, 1963	Denison	11
November 13, 14, 1963	Earlham	11
November 18, 19, 1963	DePauw	21
November 18, 20, 1963	Wabash	6
December 2, 3, 1963	Kalamazoo	5
December 9, 10, 1963	Albion	13
December 11, 12, 1963	Wooster	6
December 17, 18, 1963	Antioch	11
January 14, 15, 1964	Oberlin	2
January 20, 21, 1964	Kenyon	2
TOTAL		104

The average number of faculty contacts at each campus was 8.7 persons.

Appendix A-2

SUMMARY OF FACULTY PARTICIPATION QUESTIONNAIRES

College	# of FPQs Returned	Number of Faculty Members Willing to Test Published Programs	Faculty Members Willing to Test GLCA Programs	Faculty Members Willing to Inspect Programs
Albion	34	6	8	3
Antioch	12	4	4	4
Denison	48	10	19	17
De Pauw	60	23	25	16
Earlham	26	8	13	8
Hope	22	6	11	6
Kalamazoo	8	2	2	4
Kenyon	32	5	14	15
Oberlin	18	4	7	11
Ohio Wesleyan	46	15	18	25
Wabash	25	4	6	9
College of Wooster	38	6	12	17

Appendix A-3

PROGRAMS RECEIVED BY THE PROJECT

Decimals and Percents	1	Mathematics Misc.	3
Business Education and Economics	6	Sets	3
Grammar and Usage	5	Statistics	5
Punctuation, Spelling, etc.	3	Trigonometry	2
Language Arts	4	Medicine	1
Modern Language	4	Programing	6
Mathematics	8	Religion	3
Applied Mathematics	5	Electricity	5
Algebra	6	Electronics	1
Geometry	2	Biology	5
Logic	1	Chemistry	16
		Physics	1
		Psychology	7
		Social Studies	5

Appendix A-4

NUMBER OF FACULTY PARTICIPATION QUESTIONNAIRES RETURNED

Albion	34	Kalamazoo	10
Antioch	9	Kenyon	38
Denison	48	Ohio Wesleyan	47
DePauw	60	Wabash	26
Earlham	26	Wooster	38
Hope	22		

Appendix A-3

PROGRAMS RECEIVED BY THE PROJECT

Decimals and Percents	1	Mathematics Misc.	3
Business Education and Economics	6	Sets	3
Grammar and Usage	5	Statistics	5
Punctuation, Spelling, etc.	3	Trigonometry	2
Language Arts	4	Medicine	1
Modern Language	4	Programing	6
Mathematics	8	Religion	3
Applied Mathematics	5	Electricity	5
Algebra	6	Electronics	1
Geometry	2	Biology	5
Logic	1	Chemistry	16
		Physics	1
		Psychology	7
		Social Studies	5

Appendix A-4

NUMBER OF FACULTY PARTICIPATION QUESTIONNAIRES RETURNED

Albion	34	Kalamazoo	10
Antioch	9	Kenyon	38
Denison	48	Ohio Wesleyan	47
DePauw	60	Wabash	26
Earlham	26	Wooster	38
Hope	22		

Appendix A-5

PARTICIPANTS IN HUMANITIES WINTER WORK CONFERENCE

February 28-29, 1964

Art Department

William Darr
Earlham College

Paul Arnold
Oberlin College

Forbes Whiteside
Oberlin College

J. Stewart
Ohio Wesleyan

Anna Otten
Antioch College

Resource Person - Dr. Dan Smith
Earlham College

Speech Department

John Foxen
DePauw University

H. Sharp
College of Wooster

Resource - Prof. Donald Ecroyd
Temple University

English Department

James Cook
Albion College

Paul Loukides
Albion College

Kenneth Marshall
Denison University

Fred Bergman
DePauw University

English Dept. (cont'd.)

A. Ferguson
Ohio Wesleyan

Samuel Pratt
Ohio Wesleyan

C. Mittelstadt
Kalamazoo College

Dr. Harold Moon - Resource Person
Steven, Jordan & Harrison
New York, New York

Romance & Modern Language

Jean Keller
Albion College

Fred Preston
Denison University

Guy Stern
Denison University

LeGrand Tennis
DePauw University

Robert Brewster
Earlham College

Charles Matlack
Earlham College

Gerhard Megow
Hope College

Resource - Prof. Fernand Marty
Hollins College, Va.

Music Department

Carl Eschman
Denison University

Appendix A-5 (cont'd.)

Music Dept.(cont'd.)

Floyd Peterson
DePauw University

Lawrence Smith
Kalamazoo College

Paul Schwartz
Kenyon College

Resource Person - Dr. Robert Barnes
Ohio State Univ.

Philosophy Department

Mort Schragrin
Denison University

Harry Booth
Ohio Wesleyan

L. Hackstaff
Wabash College

General Resouce Person

John Blyth

Other Media

Resource Person - Louis Forsdale
Columbia University
New York, New York

Religion Department

Lee O. Scott
Denison University

Hugh Barbour
Earlham College

Robert Montgomery
Ohio Wesleyan

Resource Person - John Blyth
The Diebold Group, Inc.
New York, New York

Appendix A-6

PARTICIPANTS IN NATURAL SCIENCES WINTER WORK CONFERENCE

March 6-7, 1964

Biology Department

D. G. Dillery
Albion College

Preston Adams
DePauw University

Wm. Stephenson
Earlham College

Biology Dept. (Cont'd.)
Phil Crook
Hope College

Francis Yow
Kenyon College

Donald Smith
Ohio Wesleyan University

Resource Person - Dr. Loche Van Atta, Oberlin College

Appendix A-6 (cont'd.)

Chemistry Department

John Brown
Denison University

Conrad Ronneberg
Denison University

John MacFarland
DePauw University

Owen York
Kenyon College

Gordon Johnson
Kenyon College

Peter Hawkins
Oberlin College

Werner Bromund
Oberlin College

Richard King
Ohio Wesleyan University

James Loehlin
College of Wooster

Resource Person - Dr. Theodor Benfey
ACS Applied Publications

Geology Department

Ansel Gooding
Earlham College

C. L. Bieber
DePauw University

Resource Person - Dr. Dan Smith
Earlham College

Mathematics Department

E. E. Ingalls
Albion College

Mathematics Dept. (Cont'd.)

W. K. Moore
Albion College

Andrew Sterrett
Denison University

Thomas Davis
DePauw University

Robert Thomas
DePauw University

Harold Hanes
Earlham College

Ruth B. Smyth
College of Wooster

Resource Person - Mr. James
Evans, Teaching Materials, Inc.

Physics Department

Hugh Henry
DePauw University

William Achor
Earlham College

R. J. Stephenson
College of Wooster

Resource Person - Mr. Harvey
J. Brudner,
New York Institute of
Technology

Physical Education

Betty Beese
Albion College

J. W. Falkenstine
Kenyon College

Resource Person - Mr. Stanley
Hall, Earlham College

Appendix A-6 (cont'd.)

Library

Marian Mullendore
DePauw University

Peter Kidder
Kenyon College

J. McRee Elrod
Ohio Wesleyan University

Evan Farber
Earlham College

Resource Person - Anne Martin
University of Pittsburgh
Graduate Library School

General Resource Person

Dr. James Evans

Other Media

John Swayze
Columbia University
New York, New York

Appendix A-7

PARTICIPANTS IN SOCIAL SCIENCES WINTER WORK CONFERENCE

March 20-21, 1964

Economics Department

C. G. Pelekoudas
Antioch College

Laurel E. Pease
Denison University

Norman Erb
DePauw University

Fred S. Silander
DePauw University

John Komives
Kalamazoo College

Vant Kebker
Ohio Wesleyan University

Resource Person - Dr. Irwin
Hernstadt,
Northeastern University
Boston, Massachusetts

Education Department

Eleanor T. McLaughlin
Albion College

Clinton Green
DePauw University

Martha E. Dallman
Ohio Wesleyan University

Harry F. Schlichting
Ohio Wesleyan University

Joseph Wetmore
Ohio Wesleyan University

Resource Person - Dr. Daniel Smith
Earlham College

Political Science Department

L. M. Pelekoudas
Antioch College

Thad L. Beyle
Denison University

James A. Funston
Earlham College

Wen C. Chen
Kalamazoo College

Resource Person - Dr. John
Ferguson
Pennsylvania State University

Psychology Department

Clarence Leuba
Antioch College

Ira London
Denison University

Kenneth Wagoner
DePauw University

Richard C. Kelly
DePauw University

Frank S. McKenna
DePauw University

Rex Rector
DePauw University

Phillip Van Eyl
Hope College

Robert Brown
Hope College

Appendix A-7 (cont'd.)

Psychology Dept. (cont'd.)

Thomas Clifford
Kenyon College

Hubert Bonner
Ohio Wesleyan University

Sam Cho
College of Wooster

Resource Person - Dr. Dale Brethower
University of Michigan

Sociology Department

Paul A. Thomas
DePauw University

Richard Knudten
College of Wooster

Resource Person - Professor Leslie
Malpass
University of South Florida

General Resource Person

Mr. George Geis, University of Michigan

Other Media

Anne Rosengren
Columbia University
New York, New York

History Department

Edward Moritz, Jr.
Kalamazoo College

Charles Hamilton
Kenyon College

Resource Person - Professor
Leslie Malpass
University of South Florida

Appendix A-8

RESOURCE PERSONS AT WINTER WORK CONFERENCES

Humanities

Art	Daniel Smith, Director of Self-instructional Project, Earlham College
Speech	Donald Ecroyd, Professor Of Speech, Temple University
English	Dr. Harold Moon, Research Associate and task leader in training research at the Human Resources Research Office, formerly manager of McGraw-Hill Programed Instruction Unit.
Modern Language	Professor Fernand Marty, Department of Modern Languages Hollins College, Virginia
Music	Dr. Robert A. Barnes, Assistant Professor at the School of Music, Ohio State University
Philosophy	John Blyth
Other Media	Louis Forsdale John Swayze Anne Rosengren

Natural Sciences

Education	Daniel Smith
Biology	Locke Van Atta, Department of Biology, Oberlin College
Chemistry	Dr. Theodor Benfey, Department of Chemistry, Earlham College
Mathematics	Dr. James Evans
Physics	Dr. Harvey J. Brudner, New York Institute of Technology
Physical Education	Dr. Stanley Hall, Department of Physical Education, Earlham College
Library	Dr. Anne Martin, Research Director, Center for Library and Educational Media Studies, Graduate Library School, University of Pittsburgh

Appendix A-8 (cont'd.)

Social Sciences

Geology	Dr. Daniel Smith
Economics	Dr. Irwin Hernstadt, Assistant Professor of Economics, College of Business Administration, Northeastern University, Boston
Political Science	J. H. Ferguson, head Department of Political Science Pennsylvania State University
Psychology	Dr. Dale Brethower, Center for Research on Learning and Teaching, University of Michigan
Sociology	Dr. Leslie Malpass, Professor and Chairman Behavioral Sciences Division, University of South Florida, Tampa, Florida

0

Appendix A-9

PARTICIPATION IN WINTER WORK CONFERENCES BY COLLEGES AND DISCIPLINES

	Albion	Antioch	Denison	DePauw	Earlham	Hope	Kalamazoo	Kenyon	Oberlin	Ohio Wesleyan	Wabash	Wooster	Totals
Humanities													31
Art					1				2	1			4
English	2		1	1		1	1			1			7
Drama								1					1
Modern Languages	1	1	2	1	2	1					1		9
Music				1			1	1					3
Philosophy			1								1		2
Religion			1		1					1			3
Speech				1			1						2
Natural Sciences													33
Biology	1			1	1	1		1		1			6
Chemistry			2	1				2	1	2		1	9
Geology				1								1	2
Mathematics	2		1	1	1			1				1	7
Physics				1	1							1	3
Phys Ed	1			1									2
Library				1	1			1		1			4
Social Sciences													29
Economics		1	1	2			1			1			6
Education	1			1						2			4
Political Science		1	1				1						3
Phychology		1	1	3	1	2		1	1	1		1	12
Sociology				1								1	2
History							2						2
Totals	8	4	11	18	9	5	7	8	4	11	2	6	93

Appendix A-10

DISTRIBUTION OF AWARDED GRANTS FOR PREPARING PROGRAMED MATERIALS BY COLLEGES AND DISCIPLINES

	Albion	Antioch	Denison	DePauw	Earlham	Hope	Kalamazoo	Kenyon	Oberlin	Ohio Wesleyan	Wabash	Wooster	Totals
Number of Proposals Red'd	6	5	8	15	7	2	4	3	4	6	1	2	63
Art									1¼				1¼
English	1		1										2
Modern Language			¼		1						1*		2¼
Music							1	1					2
Philosophy			1										1
Religion										1			1
Biology				1	1¼								2¼
Chemistry									1				1
Geology					1								1
Mathematics				1									1
Economics				1						1			2
Education										1			1
Political Science													
Psychology		1	¼	1		1							3¼
Sociology												1	1
Library				¼	¼			¼		¼			1
Totals by College	1	1	2½	4¼	3½	1	1	1¼	2¼	3¼	1	1	23

*Cancelled out because of illness. In addition to the above grants two half-time year long grants were awarded--one in geology and one in political science to two faculty members at Antioch College.

Appendix A-11

PERSONS INSPECTING PROGRAMED MATERIALS

Program	#Inspecting materials	Program	#Inspecting
Mathematics	16	Religion	2
Modern Languages	9	Sociology	2
Physics	8	Librarians	2
Music	7	English	4
Psychology	6	Economics	1
Chemistry	6	Political Science	1
Biology	4	Geology	1
Statistics	4	History	1
Logic	2	Phys Ed (Health)	1

Appendix A-12

SCHEDULE OF SUMMER 1964 WORKSHOPS

Workshop Schedules

Below is the schedule for the first week's training workshop.

Sunday, June 14

Check into Fairlane Inn Motel by 5:30 p.m.

Dinner - Greetings by Stanford C. Erickson, Director of the Center for Research on Learning and Teaching at the University of Michigan.

Evening - Demonstration and Discussion: What is a program?

Monday, June 15

A.M. - Work through Practicum in Programing.

Luncheon Speaker: George L. Geis; Topic: The Programing Process.

P.M. - Finish Practicum. Begin analysis of subject matter.

Evening - Dinner. Speaker: Charles E. Wesley, Co-ordinator, Work Study Program, Dearborn Campus, the University of Michigan. (A tour of the Fairlane Estate is available after dinner.)

Tuesday, June 16

A.M. - Analyze subject matter. Define objectives of your program; Write terminal frames. Luncheon: Speaker: Robert R. Wilson Supervisor of Correspondence Study and Programed Instruction, Extension Service, The University of Michigan. Topic: Extra-Campus Instruction and Programed Instruction.

Wednesday, June 17

A.M. - Discuss and write teaching frames. Dale Brethower. Luncheon: Speaker - Donald E. P. Smith. Topic: A Program in Reading.

P.M. - Continue writing teaching frames. Discussion: The Student as a Test Instrument.

Evening - Homework, review and revise teaching frames.

Thursday, June 18

A.M. - Arrive at Ann Arbor campus to view and discuss kinescope of testing.

P.M. - Test programs on each other.

Evening - review and revise teaching frames.

Friday, June 19

A.M. - Discuss and plan summer work. Arrive at Ann Arbor campus at 12:30 for luncheon.

P.M. - Reception at Center for Research on Learning and Teaching. Tour of Ann Arbor Campus.

Below is the schedule of the second week's training workshop.

Sunday, July 12

Check into Fairlane Motel by 5:30 p.m.

Dinner

Evening - Discussion groups discussing problems of programing incurred since first workshop session.

Monday, July 13

A.M. - Presentation of data from test subjects to editors. Luncheon. Speaker: David Markle. Topic: Movies and Programing.

P.M. - Revise and rework program and programing.

Evening - Review and revise teaching frames.

Tuesday, July 14

A.M. - Continue revision. Luncheon Speaker: Harlan Lane. Topic: Programing and Speech Therapy.

P.M. - Run paid students as subjects on program.

Evening - Revise and rework programs.

Wednesday, July 15

A.M. - Final revision and field test planning.

P.M. - Discuss program management and evaluation.

Evening - Revise and rework program.

Thursday, July 16

A.M. - Speaker: D. Bem. Topic: Programing for Mentral Retardates. R. Richards. Topic: Listening Program.

P.M. - Free time for tours, etc.

Friday, July 17

A.M. - Speaker: Dale Brethower, George Geis. Topic: Research in Programed Instruction.

P.M. - Luncheon and adjournment.

Appendix A-13.

REPORT OF CHEMISTS FROM THE WINTER WORK CONFERENCES,
Distributed to Department Chairman

Report on Chemistry Discipline Group

Present: John Brown, Denison; Conrad Ronneberg, Denison; John McFarland, DePauw; Owen York, Kenyon; Gordon Johnson, Kenyon; Peter Hawkins, Oberlin; Werner Bromund, Oberlin; Richard King, Ohio Wesleyan; James Loehlin, College of Wooster; Ted Benfey, Earlham, Resource Person.

Available Programed Materials in Chemistry

Most published or mimeographed programs were on view at the conference. They were studied at some length and commented upon intermittently.

Loehlin will prepare a list of all known chemistry programs. The list will be sent to all participants in the chemistry group.

The large majority of the programs are either remedial or adjunct programs. Very little work has been done so far in transferring standard lecture material to programed form. Almost all the chemistry programing is on the freshman level.

Testing Present Material

1. King plans to try out Walter Hunter's program on Symbols and Circuitry, Earlham, in his instrumental analysis course, this spring.

2. McFarland plans to try out Benfey's Aliphatic Nomenclature programs this spring.

3. Next fall, Johnson and York are planning to test parts of Barrow's program; King will try out parts of either Barrow or Jay Young.

Preparation of Programs.

1. Brown proposes full-time programing this summer on:

    a) Phase Rule and its applications

    b) One or more physico-chemical derivations and their applications such as Clausius-Clapeyron equation, Boltzmann distribution law, Debye-Huckel equation.

E

2. McFarland will probably apply for half-time programing this summer on functional group reactions in organic chemistry.

3. Ronneberg may work on basic concepts for a physical science course, such as concepts of force, energy, kinetic molecular theory, Newton's laws.

4. York, King and Bromund are considering programing instructions for certain instruments, e.g. Spectronic 20, Bromund; Gas Chromatograph, York; Perkins-Elmer IR-21 (King); single pan balance, Bromund; Beckman DU and DB; infracord; pH meters; refractometer; Bausch & Lomb 505.

5. Hawkins is thinking of programing preliminary material in organic chemistry for a course using the Cram and Hammond text so that lectures can very quickly focus on mechanisms of organic reactions. Content would include some material on structure, and a skeleton set of reactions interrelating functional groups.

Some Topics Discussed

Types of Programs: Linear vs. Intrinsic; Linear, with Loops; Washbacks, Optional Frames, etc.

Purposes of Programs in Chemistry Teaching

a) Permit something of a socratic dialogue in large classes.
b) Reduce the large diversity of chemical knowledge of students beginning the course.
c) Cover material for which there is no time in class.
d) Drill work for students; extra samples beyond those discussed in class.
e) Rote learning; value of programing for this purpose was questioned unless allogical logical order of presentation of the material can be found.
f) Develop skills in areas adjunct to chemistry, e.g. mathematical preparation.
g) Presentation of closely argued and logically coherent material which is not learned effectively through lectures.

Some Areas Where Programs Are Likely to be Useful

For Freshmen: Algebra, linear equations, direct and inverse proportions and their graphical expressions, exponents, logarithms, significant figures (some questions about this), gas laws manipulating chemical equations; simple thermodynamics.

Discriptive chemistry of illustrative elements taught as examples of previously learned Theoretical principles.

Appendix A-13 (cont'd.)

Nomenclature: Organic - Stereochemistry, simple functional group chemistry
Analytical - Electronics for chemists: instructions for use on instruments.
Physical Chemistry - Mathematical preparation for physical chemistry, physicochemical derivations.

Follow-up: No formal organization was set up. Programers and program testers will plan to keep in touch with others in the group involved in similar projects.

Materials or information for the whole group or for all chemistry faculty in GLCA can be sent to Dr. Benfey or Dr. DeHaan.

The suggestion was made that programers and testers might meet at MACLAC and Ohio Chemistry Teachers gatherings.

It was agreed that royalty questions would need to be settled and spelled out so as to prevent confusion and misunderstanding among summer programers.

Dr. O. Theodor Benfey, Consultant
1155 - 16th Street, N. W.
Washington, D. C. 20036

In addition 13 programs in chemistry were reviewed and the reviews were distributed to all the chemistry department chairmen.

Appendix A-14

SURVEY OF USE OF PROGRAMED INSTRUCTION
December 1964

Biology

College	Course in which Program is Used	Name of Program	Use	On this Basis	Number Students Using Program	Subject Areas where Program would be used if available
Albion	Botany-Zoology	The Cell	supplement	Vol. & required	32	Remedial
DePauw U.	Botany	Plant Anatomy - Adams	supplement	required	50	
Earlham	Biology	Meiosis, Mitosis Monohybrid Inheritance, DiHybrid Inheritance	integral	required	170	
Earlham	Biology	Cell structure & Function, DNA, RNA Information transfer	integral	required	170	metabolism
Earlham	Biology	Biochemistry for Biologists	integral	required	170	
Earlham	Biology	Genetics Problems Probability Family Histories	integral	required	62	
Earlham	Physiology	Ph Osmotic Pressure	integral	required	55	
Kenyon	Biology	Chemistry for Biologists	integral	required	48	Genetics
Oberlin	Gen. Biology	Intro. to Genetics	integral	required for some	100	Phylogeny
Ohio Wesleyan	Zoology	Biochemistry for Biologists	supplement	voluntary	49	Zoology 10 Ornithology,etc
Wooster						Genetics

USE OF PROGRAMED INSTRUCTION
December 1964

Chemistry

College	Course in which Program is Used	Name of Program	Use	On this Basis	Number Students	Subject Areas where Program would be used if available
Albion	General Chem.	Molecular Equilibrium	supplement	voluntary	75	
Albion	General Chem.	Programed Suppl. General Chem.	supplement	voluntary	20-30	
Antioch	Organic II	Systematic Naming of Organic Com.	supplement	voluntary	24/quar.	Gen. Chem. Problems, Descriptive Chem.
DePauw U.	Organic	Systematic Naming of Organic Com.	supplement	required	34	
Earlham	Chem. 13	Structure of Organic Molecule	integral	required	19	
Earlham	Chem. 13	Naming of Organic Compounds	integral	required	19	
Oberlin	Organic	Some aspects of ...Stereomerism	integral	required	50	
Oberlin	Gen. Chem.	Programed Supp. Gen. Chem.	remedial	voluntary	20	
Ohio Wes.	Chem. 10C	Borrow & Young	remedial	voluntary	8	
Wabash	Phys. Chem.	Chem. Study Group	supplement	voluntary	20	
Wooster	Chemistry	Barrow	supplement	voluntary	40-50	

USE OF PROGRAMED INSTRUCTION
December 1964

College	Course in which Program is used	Name of Program	Use	On this Basis	Number Students Using Program	Subject Areas where Program would be used if available
Education						
Antioch	Curricular Methods	Use of Audio-Visual Aids	supplement	required	15/quar.	
DePauw U.	Composite Secondary Educa.	Public School Finance -Wetmore	supplement	required	35	
Ohio Wes.	Education 83	Public School Finance - I	integral	required	40	Teacher Ethics Salaried School Admin.
	Education 45	Statistical Measures	integral	required	62	Theories Learning
Wooster						Tests and Measurements
Economics						
Antioch	Economics Principles & Practic	Uses of Theory	supplement	required	30	
DePauw U.	Principles of Economics	Nature of Theory F. Silander	integral	required	30	
DePauw U.	Finance and Investment	Capital Building V. Kebker	integral	required	30	
DePauw U.	Business Statistics	Basic Statistics Concepts by Bradley &Clelland	remedial	voluntary	3	
Kenyon						Theory of costs supply & demand, money & banking
Ohio Wes.	Economics 83 (Tested Program)	Capital Budgeting	(field test)	required	17	Cost of capital
Wooster						Mathematical Economics

USE OF PROGRAMED INSTRUCTION
December 1964

English

College	Course in which Program is Used	Name of Program	Use	On this Basis	Number Students Using Program	Subject areas where Program would be used if available
Hope	Non-credit	How To Read a Textbook	remedial	voluntary	6	Grammar and sentence improvement
Ohio Wesleyan	English A	How To Read a Textbook	supplement	required	21	
Ohio Wesleyan	Freshman Eng.	Effective Writing, Smith & Smith	remedial	voluntary	8	Tutorial Courses
Ohio Wesleyan	English D	Effective Writing, Smith & Smith	integral	required	21	
Ohio Wesleyan	English 30 (GlCA Field test)	Poetry: Method and Meaning	supplement	required	15	
Wooster						Phonology Linguistics
Kalamazoo	Am. Literature (57)	Figures of Speech	integral	required	41	

Geology & Geography

College	Course in which Program is Used	Name of Program	Use	On this Basis	Number Students Using Program	Subject areas where Program would be used if available
Antioch	Earth Science I, Physical Geology	Basic Concepts	integral	required	15/quar.	crystals
Earlham	Physical-Geology	Crystal Structure	integral	required	100	
Ohio Wesleyan	Geology 10	Crystalography	supplement	required	140	Geology & Mineralogy
Wooster						Physical & His. Geology

USE OF PROGRAMED INSTRUCTION
December 1964

Mathematics

College	Course in which Program is used	Name of Program	Use	On this Basis	Number Students Using Program	Subject Areas where Program would be used if available
Albion	Analytical Geometry	Analytical Geometry	integral	required	30	any good one would be used
Antioch	Calculus I	Temac-Introduction to Calculus	supplement	voluntary	5/quar.	All Calculus Albegra, Trig.
Antioch	Statistics	To be selected	integral	required	40-60/quar.	Almost any math course
DePauw U.	Calculus I	Analytic Geom Line-Davis	supplement	required	50	
Earlham	Calculus 21	Analytic Geom	supplement	required	77	Limits Definite integral
Earlham	Calculus 21	Programed topics in calculus	supplement	required	80	
Earlham	In-service instructors in highschool	Programed topics in calculus	supplement	required	27	
Earlham	Calculus 22	Programed topics in calculus	integral	required	30	
Ohio Wes.	Math. 20	Trigonometry	supplement	voluntary	20	
Wabash	Math. 3	Encyclopaedia Britannica Cal.	special students	voluntary	2	
Wooster	Trigonometry	Temac Trig.	integral	required	50	

USE OF PROGRAMED INSTRUCTION
December 1964

College	Course in which Program is used	Name of Program	Use	On this Basis	Number Students Using Program	Subject areas where Program would be used if available
Languages						
Antioch	French I, II, III	Not Decided	integral	required	60-80	
Antioch	Spanish I	Tapes, Language Labs, Plan to use non-tapes, self-compiled program				
Kenyon						Possibly all linguistic instruction, but not lit.
Hope	Elementary German		integral	required	145	
Hope	Intermediate German		supplement	required	110	
Music						
Albion	Theory	To be chosen				
DePauw U.	Music Appre.	Musical Score Reading-Schwartz	supplement	voluntary	30	
Earlham	Intro. Music II General	Tone, Color & media of performance	integral	required	50 entire pro, 100 first half	Intro. for Gen., Intro for Majors
Earlham	Music II	Musical Score Reading	supplement	voluntary	30	
Kenyon	(trial basis) Basic III Arts	How to Follow a Musical Score	integral	required	194	Intro. Courses

OF

USE OF PROGRAMED INSTRUCTION
December 1964

Music (continued)

College	Course in which Program is Used	Name of Program	Use	On this Basis	Number Students Using Program	Subject Areas where Program would be used if available
Oberlin	Intro. Theory	Scales, Intervals, Keys, Triads	remedial	required	45	Elem. rhythm, pitch, meter signatures
Wooster						Elem. Theory Music History
Physical Education						
Albion						Swimming, Physiology of Exercise Kinesiology
Kalamazoo	Women's Phys. Educa.		integral	required	all	
Physics						
Antioch	Engineering Fundamentals	Graphics	integral	required	10/quar.	Any area of engineering
Albion						Intro. Courses
Kenyon						Possibly elementary work
Wooster						Elementary Physics

USE OF PROGRAMED INSTRUCTION
December 1964

Psychology

College	Course in which Program is Used	Name of Program	Use	On this Basis	Number Students Using Program	Subject Areas where Program would be used if available
Antioch	Research Methods in Psychology	Statistical Concepts	integral	required	12/quar.	Reviews to supplement text
DePauw U.	Psychology of Business & Industry	Personnel Selection	integral	required	34	
Earlham	Ed. Psych. & Measurements	Apparent and Classical Conditioning	integral	required	100	Balance Theories
Earlham	Ed. Psychology	Statistics (Mean, Standard Deviation, Significant Differences, Correlations in terms of variance	integral	required	100	Associative Learning - Concept Formation
Earlham	Intro. Psych.	Human Relations Development	supplement	required	33	Other areas Concept of Learning
Kenyon	Psychology Measurements	Psychological Measurements, Statistics - Gotkin & Goldstein, McCullough and Van Atta	integral	required	6	Statistics
Oberlin	Intro. Psych.	Analysis of Behavior	supplement & remedial	voluntary	30	Diagraming simple conditioning patterns
Oberlin	Intro. Psych.	Statistical Concepts	supplement	required	180	
Wooster						Physiological Psychology

USE OF PROGRAMED INSTRUCTION
December 1964

Religion

College	Course in which Program is used	Name of Program	Use	On this Basis	Number Students Using Program	Subject Areas where Program would be used if available
Albion						Bible
Ohio Wesleyan	Religion 10	Studies in the Gospels	Integral	required	118	
Sociology						
Albion						Areas in Anthropology, Social theory, Intro. sociology
Wooster						Elementary Statistics Population

Appendix B-1

INSTRUCTOR PROGRAM EVALUATION FORM

1. Name________________________Date_______Course_____________________

2. Institution____

3. Name of Program____

Prior Experience with Programed Material

4. Have you ever used programed material before this time?	4. ______Yes ______No
If the answer is yes to question 4, answer 5 and 6.	
5. In what courses did you use programed material?	5. ____ ____ ____

6. ______As a reference work

______As a primary teaching device in place of lectures

______For remedial work when the student falls behind

______for enrichment for students who want more

______To bring students up to starting level of the course

______To teach material that the instructor does not want to cover in class

______other (describe it)______

____

Appendix B-1 (cont'd.)

7. Describe your attitude toward programed instruction prior to evaluation of the material for GLCA. Comment if you wish:________________________

____

7. ______Enthusiastic
______Favorably disposed
______Uncertain
______Unfavorably disposed
______Strongly disapprove

General Reaction

8. Will you please describe in your own words your reaction to and evaluation of the programed material you used. More specific questions will be asked later in this questionnaire, and you may wish to return to this question after you have responded to them.

Please use the back of this sheet if you wish to make more comments than the above space allows.

Specific Reaction (Add any comments you wish to your answers)

9. Does the program cover essentially the same material that you desire to cover in part or the whole of your course?

9. ____Yes ____No

Comment:____________________

____

10. Are there any errors in the content? 10. ____Yes ____No

11. If you answered yes to question 10, are they major or minor errors? 11. ___Major ___Minor ___Both

Give examples of frame number and page________________________

____

12. Are there any technical program errors, e.g., poor directions, points of confusion, etc? 12. ____Yes ____No

Comment:

Give examples by frame number and page:

13. In your opinion does the program actually teach what it claims to teach to the student for whom it is presumably designed? 13. ___Yes
___No
___Partly

If your answer is "No" or "Partly" to Question 13 above, what claims are exaggerated?____________________

____

____

14. Are the responses that the student is required to make token or real? (That is, do the frames merely required mechanical filling in or do they require thought and/or problem solving)? 14.___Mostly token responses
___Mostly real responses
___Spotty, some of both

15. Does it happen that the same response it required again and again in a series of frames? 15.___Yes
___No
___Occasionally

16. Evaluate the pace of the program 16.___Too fast
___Too slow
___Uneven
___About Right

17. Evauate "step size" or amount of information presented in each frame. 17.___Too big
___Too small
___Uneven
___About right

18. Does the student get a sense of direction where he is going from the program? 18.___Yes
___No
___At times

Appendix B-1 (cont'd.)

19. Can the student easily review the programed material?	19. ___Yes ___No ___At times
20. Are criterion (terminal) frames identifiable? (Criterion frames do not present new information.	20. ___Yes ___No ___At times
21. Does the importance and amount of content covered justify the amount of time required of the student?	21. ___Yes ___No ___Uncertain
22. Does the program save the instructor time?	22. ___Yes ___No ___Uncertain
23. Is the program justified in terms of its cost?	23. ___Yes ___No ___Uncertain
24. Is the following information about the program available?	24. yes uncertain no
a. Was the program adequately tested prior to publication?	a. ___
b. If so, does it describe the characteristics of the students on whom it was tested?	b. ___
c. Are the results of the testing given?	c. ___
d. Are pre and post-test available?	d. ___
25. Do you know of better or similar programs or comparable material? If yes, what?___	25. ___Yes ___No
26. Does the teacher's manual or the introduction to the program state explicitly the objectives of the program? Comment___	26. ___Yes ___No
27. Does the program state explicitly the prerequisites or "entering behaviors" for the student for whom it is designed? Comment___	27. ___Yes ___No

but test the student
on his mastery of material
[illegible]

Appendix B-1 (cont'd.)

28. Would you prefer to have students use a regular textbook or a programed version of the material? Comment if you wish______________

____

28. Prefer programed material?

____

Indifferent__________

Prefer lecture________

29. As a method of presenting material, would you prefer to lecture or the use of programed material?

29. Prefer programed material

____

Indifferent__________

Prefer lecture________

30. Estimate total number of hours you spent on testing these programed materials, including conferences with director, etc.__________hrs.

31. In summary, what is your overall reaction at this time to using programed material in this course?

Comment if you wish______________

____

____

31. ____Very positive, would like to use similar material again

____More positive than negative reaction to it

____Indifferent to using it

____More negative than Positive reaction to it

____Very poor, would object to using it again

Appendix B-2

STUDENT REACTION QUESTIONNAIRE

Fall 1964

As you may know, you have been participating in a research project designed to compare the use of programed instructional methods with usual methods of presenting materials in a college course. We would like to compare your reactions to the methods used in your course to the reactions of other students who have used programed materials. Will you kindly answer the questions about the methods and materials below? This questionnaire is to be used for research purposes only and will not affect your grade.

1. Name____________________ Date__________ Course__________

2. Name of program______________________________

3. Your major or intended major____________________
Your career choice____________________

Prior Experience, if any, with Programed Material

4. Have you ever used programed material?

4. ____Yes
____No

If you answered yes to question 4, answer 5 and 6. Otherwise go on to the next page.

5. Where have you used programed material?

5. ____High School
____In how many courses?
____College
____In how many courses?
____Home (describe it)
____

6. How was the programed material used?

6. ____As a reference work

____As a primary teaching device in place of the textbooks

____As a primary teaching device in place of lectures

____As a supplement to textbooks and lectures

8

Appendix B-2 (cont'd.)

6. (cont'd.)

____For remedial work when the student falls behind

____For enrichment for students who want more

____To bring students up to starting level of the course

____To teach material that the instructor does not want to cover in class

____Other (describe it)

____

Evaluation of Educational Methods Used in this Course

7. Check the term(s) on the right that most adequately describe the major educational methods used in this course. If more than one method was used, write a numeral 1 in front of the one that received major emphasis.

7. ____lecture
____textbook
____discussion groups
____independent study
____laboratory
____field work
____other (describe it)

____

____

In answering the following questions, use what you have checked in Question 7 as your point of reference. For example, if you checked "textbook" as a major educational method in 7, let the rest of your answers apply to text books.

Appendix B-2 (cont'd.)

8. What is your overall reaction at this time to the educational method(s) used in this course? Comment if you wish____________ ________________________________ ________________________________	8. ____Very positive learning experience, would like to use similar again ____More positive than negative reaction to it ____indifferent to using it ____More negative than positive reaction to it ____Very poor learning experience, would object to using it again
9. As a method of being exposed to knowledge and information, how would you rate the educational methods used in this course? Comment if you wish____________ ________________________________ ________________________________	9. ____Very effective ____Usually effective ____Mixed ____Usually ineffective ____Very ineffective
10. Considering what you learned from the methods in this course, was it worth the time you spent on it? Comment if you wish____________ ________________________________ ________________________________	10. ____Yes ____Uncertain ____No
11. Did you have a sense of direction, of knowing where you were going, a feeling of getting somewhere in the course? Comment if you wish ________________________________ ________________________________ ________________________________ ________________________________	11. ____Yes ____Most of the time ____Sometimes ____Usually not ____No

0

Appendix B-2 (cont'd.)

12. Could you easily review the course materials?	12.	____Yes ____Uncertain ____No
13. Charaterize the method(s)used in this course as you experienced it. Check those statements that apply.	13.	____Speeded my learning ____Impersonal ____Gave me a feeling of making progress ____Mechanical ____Challenging ____Too hard ____Other (describe in your own words)____________
14. Characterize further the method(s) used in this course as you experienced it. Check those statements that apply.	14.	____too easy to skim ____Not worth the time I put into it ____Made me think ____Too easy ____Did not hold my attention ____In spite of any disadvantages, I learned much ____Other (describe it)

Appendix B-2 (cont'd.)

15. As you see it now, what is your preferred way of being exposed to knowledge and information in your college studies. Place a numeral 1 in front of your first choice, 2 in front of second choice, etc.

15. ____lecture
____textbooks
____discussion groups
____independent study, supervised
____laboratory
____Writing research papers
____field work
____informal bull sessions
____unsupervised, free reading
____Other (describe it)

____

____

16. How has the use of the methods employed in this course affected your attitude toward the subject matter of this course? Comment if you wish____________

____

16. ____Favorably

____No appreciable effect

____Unfavorably

17. Please write any other specific or general comments you wish on the back

Appendix B-3

GLCA FIELD TESTERS, 1964

	Programer	Field Testers	
1.	Prof. Preston Adams Dept. of Botany DePauw University		
2.	Prof. R. Brewster Dept. of Languages Earlham College	Dr. E.F. Gearhart Dept. of Languages Hope College	
3.	Prof. James Cook Dept. of English Albion College	Dr. Robert H. Ross Dept. of English Ohio Wesleyan U.	Dr. Walter Waring Dept. of English Kalamazoo College
4.	Prof. T. A. Davis Dept. of Math DePauw University	Dr. W. Keith Moore Dept. of Math Albion College	Dr. Andrew Sterret Dept. of Math Denison University
			Dr. Harold Hanes Dept. of Math Earlham College
5.	Prof. Ansel Gooding Dept. of Geology Earlham College	Prof. C.L. Bieber Dept. of Geology DePauw University	Prof. G.H. Crowl Dept. of Geology Ohio Wesleyan U.
6.	Prof. Peter Hawkins Dept. of Geology Earlham College	Dr. Theodore Benfey Dept. of Chemistry Earlham College	
7.	Prof. Vant Kebker Dept. of Economics Ohio Wesleyan U.	Prof. F. Silander Dept. of Economics DePauw University	
8.	Prof. Richard Knudten Newberry College Newberry, S. C.	Prof. Don Clelland Dept. of Sociology Hope College	Prof. Thomas Lawrence Dept. of Sociology Newberry College
9.	Prof. Clarence Leuba Dept. of Psychology Antioch College	Dr. Frank McKenna Dept. of Psychology DePauw University	Prof. F. Grohsmeyer Dept. of Psychology Earlham College
10.	Prof. W.M. Lotkowski Dept. of Earth Sciences Antioch College		

Appendix B-3 (cont'd.)

11.	Prof. Kenneth Marshall Dept. of English Denison University		
12.	Prof. Frank McKenna Dept. of Psychology DePauw University	Prof.F.Grohsmeyer Dept.of Psychology Earlham College	Prof. H. Bahrick Dept. of Psychology Ohio Wesleyan Univ.
13.	Prof. R. Montgomery Dept. of Religion Earlham College	Prof. Hugh Barbour Dept. of Religion Earlham College	Prof. Lee Scott Dept. of Philosophy Denison University Dr. M. Vulgamore Dept. of Religion Ohio Wesleyan Univ.
14.	Prof. L. Pelekoudas Political Science Antioch College		
15.	Prof. Morton Schagrin Physical Science Dept. Denison University	Prof. L. Hackstaff Philosophy Dept. Wabash College	
16.	Prof. P. Schwartz Dept. of Music Kenyon College	Prof. Karl Eschman Dept. of Music Denison University	Prof. L. Holvik Dept. of Music Earlham College
17.	Prof. F. Silander Dept. of Economics DePauw University	Prof. R. Montgomery Dept. of Economics Denison University	Prof. Norman Erb Dept. of Economics DePauw University
18.	Prof. Lawrence Smith Prof. Ray Hammar Prof. Harry Ray Dept of Music Kalamazoo College	Prof. David Strickler Dept. of Music Albion College	
19.	Prof. W. Stephenson Dept. of Biology Earlham College	Dr. Donald Smith Dept. of Zoology Ohio Wesleyan Univ.	Prof. Francis Yow Dept. of Biology Kenyon College
20.	Dr. E.P. Van Eyl Dept. of Psychology Hope College	Prof. D. Whitted Dept. of Education Ohio Wesleyan	Prof. James McDowell Dept. of Physcholoy Earlham College

Appendix B-3 (cont'd.)

21. Prof. Joseph Wetmore
Dept of Education
Ohio Wesleyan

Prof. Milton Kraft
Dept. of Education
Earlham College

Prof. Donald Orlosky
Dept. of Education
DePauw University

22. Prof. F. Whiteside
Dept. of Art
Oberlin College

Appendix B-4
AGENDA OF FIRST TRAINING WORKSHOP
Summer 1965

Sunday, June 13

7:30 P.M.	Planning Meeting; all editors

Monday, June 14

9:30 - 11:00 A.M.	Review of working outlines of first contingent of programers. Discuss formulation of behavioral objectives.
11:00 - 12:30 P.M.	Review outlines of second contingent of programers. Begin formulation of behavioral objectives.
12:30 - 1:30 P.M.	Lunch
1:30 - 2:00 P.M.	Optional group discussion of how to formulate behavioral objectives.
2:00 - 4:00 P.M.	Work on outlines, behavioral objectives.
4:30 - 5:15 P.M.	Dan Smith, "The Process of Programing" (correct title?)
5:15 - 7:30 P.M.	Break, recreation, dinner
7:30 - 8:15 P.M.	Movie, "Program Construction"(correct title?)
8:15	Consultation with editors, formulation of objectives

Tuesday, June 15

8:30 - 12:00 A.M.	Construction of criterion questions, consultation with editors
12:00 - 1:00 P.M.	Lunch
1:00 - 2:00 P.M.	Optional group discussion of criterion behaviors and criterion test frames.
2:00 - 5:00 P.M.	Write sample criterion tests for one or two objectives, consultation with editors.
5:00 - 7:00 P.M.	Recreation break, dinner
7:00 - 8:00 P.M.	Optional group discussion writing and sequencing teaching frames.
8:00	Begin writing teaching frames, consultation with editors

Wednesday, June 16

8:30 - 12:00 A.M.	Writing teaching frames, consultation with editors
12:00 - 1:00 P.M.	Lunch
1:00 - 2:00 P.M.	Optional discussion by editors on process of using test subjects
2:00 - 5:00 P.M.	Test out program on colleagues, consultation with editors
5:00 - 7:00 P.M.	Sign out, make arrangements for editing session between workshops.
7:00	Consultation with editors

Thursday, June 17

8:30 - 11:00 A.M.	"Spill-over-editing" session (optional).

Appendix B-5

SAMPLE FORM OF EVALUATION DESIGN

1. Evaluator: Frank Yow, Biology Department, Kenyon College
2. Program: Biochemistry for Biologists by William Stephenson
3. Course in which program is to be tested: Two sections of Introductory Zoology. No. of students 60 - one large class.
4. Inclusive dates of experiment: September 20 - October 11 (retention test October 25)
5. Design #1 Group A versus Group B & c
6. Evaluation Question: Do programs teach as effectively as textbooks and lectures covering the same material?
7. Details of Design
   a. Designate one section as Group A and one section as Group B
   b. Day to day procedures are as follows:

		Period 1	Period 2	Period 3
1st week	Gr.A	1. Give Pre-test 2. Assign Program to be completed by period 2 of 2nd week	1. no class #1	1. no class
	Gr.B	1. Give Pretest #1 2. Lecture #1 and textbook assignment	1. Lecture #2 and text assignment	1. Lecture #2 and text assignment
2nd week	Gr.A	1. no class	1. Attitude Questionnaire 2. Post test #2	1. Get 5 written questions from each student 2. Discuss material
	Gr.B	1. Lecture #4 and text assignment	1. Attitude Questionnaire 2. Post Test #2	1. Get 5 written questions from each student 2. Discuss material
3rd week	Gr.A	Discuss material	1. Give Retention test #1 2. Give Attitude Questionnaire	
	Gr.B	Discuss material	1. Give Retention Test #1 2. Give Attitude Questionnaire	

8. Specific responsibilities of evaluator
   a. Tape record the discussions in class (including the names of participants.)
   b. Submit a written copy of all lectures to the project coordinator.
   c. Give a subjective evaluation of the quality of discussion in class and of the written questions of the students.
9. The evaluator will receive a stipend of $500. plus money for materials and clerical help. It is anticipated that about 10 days of the instructor's time will be required for the evaluation including conference time. The stipend will be paid when all data have been collected and forwarded to the research coordinator for processing by computer.

Appendix B-6

GENERAL RESPONSIBILITIES OF ALL PROGRAM EVALUATORS

The following checklist indicates the general responsibilities that each evaluator should carry out in conducting the program evaluation.

1. Collect student personnel data and see that it is recorded by groups on the Personnel Data Roster Forms.
2. Administer and score all tests required in the research design.
3. Administer student questionnaires according to research design and insure that they are completely filled out.
4. Complete instructor quiestionnaire.
5. Send completed Personnel Data Roster forms, student questionnaires and the instructor questionnaire, in one package, to the research coordinator at the following address:

   Professor Donald Beane
   272 Kerr Drive
   Hilliard, Ohio 43026
6. Submit bill for cost of clerical help and materials for the project to the research coordinator. (Maximum of $150 allowed for clerical help on each project.)
7. Follow evaluation design explicitly. If you have questions call the research coordinator collect, Phone (614) 876-5890.
8. Attend Training Conference at Holiday Inn, Columbus, Ohio, Airport, Thursday, 9:00 A.M.(EDT) to Friday noon, September 9 and 10. Notify Don Beane in Hilliard if you want a single or double room reservation for September 9. Reservations should be made at least one week before conference.

Appendix B-7

AGENDA OF PROGRAM EVALUATION TRAINING CONFERENCE
Holiday Inn of Columbus Airport
September 9 and 10, 1965

Thursday, September 9, 1965

9:30 A.M.	Registration and Coffee Hour
10:30 "	Progress Report on GLCA Programed Instruction Project (Film on Programing) -- Robert DeHaan
11:30 "	Procedures for Fall Testing of 1964 GLCA programs --Donald Beane
12:30 P.M.	Lunch
1:30 " -4:30	Group discussions of specific programs to be tested with the program authors (includes coffee break)
6:00 "	Distribution of programs, tests, questionnaires, etc
6:30 "	Dinner
7:30 "	Beane available for discussion of individual evaluation designed

Friday, September 10, 1965

8:00 A.M.	Breakfast
9:00 "	The Logic of Research on Evaluation of Programing -- Morton Schagrin
10:00 "	Coffee Break
10:30 "	Computer Treatment of data and interpretation -- William Jensen

Appendix B-8

PARTICIPANTS AT THE EVALUATOR'S CONFERENCE

Evaluator	College	Dates of Evaluation
P. Church	Kenyon College	Nov. 16-Dec. 16, 1965
T. Burkett	Ohio Wesleyan University	Jan. 3-19, 1966
T. Boyle	Albion College	Nov. 22-Dec. 16, 1965
*J. Cook	Albion College	
D. Anderson	Ohio Wesleyan University	Sept. 20-Oct. 8, 1965 and Jan. 4-18, 1966
B. Angel	Ohio Wesleyan University	Oct. 16-28, 1965 and Jan. 21-Feb. 11, 1966
P. Van Eyl	Hope College	Sept. 27-Oct. 8, 1965
R. DeHaan	Hope College	Oct. 5-19, 1965
J. Tovo	College of Wooster	Sept. 25-Oct. 2, 1965
*M. Schagrin	Denison University	Sept. 17-Oct. 4, 1965

Appendix B-8 (cont'd.)

Evaluator	College	Dates of Evaluation
L. Wilcox(2eval)	Earlham College	Oct. 1-Nov. 5, 1965
F. Yow	Kenyon College	Sept. 20-Oct. 25, 1965
W. Patton	Ohio Wesleyan University	Sept. 17-Oct. 2, 1965
V. Wilson	Denison University	Oct. 18-Nov. 17, 1965
*W. Stephenson(2)	Earlham College	Oct. 1-Nov. 5, 1965
D. Stegner	Illinois Wesleyan Univ.	Oct. 4-20, 1965
M. Vulgamore	Ohio Wesleyan University	Nov. 1-15, 1965
L. Scott	Denison University	Jan. 3-21, 1966
J. Stone	Illinois Wesleyan Univ.	Jan. 5-7, 1966
*R. Montgomery	Ohio Wesleyan University	
S. McNaghten	Denison University	Sept. 20-Oct. 4, 1965
B. Westbrook	Denison University	Oct. 1-9, 1965
D. Beane	College of Wooster	
Wm. Jensen	Kalamazoo College	
R. DeHaan	GLCA Director	

The following were absent with excuse:

W. Judd (Eng.)	Ohio Wesleyan University	Sept. 22-Oct. 13, 1965
C. Weis (Eng.)	Ohio Wesleyan University	Sept. 22-Oct. 13, 1965
R. Mizer (Eng.)	DePauw University	Sept. 13-27, 1965
R. Johnson (Eng.)	DePauw University	Sept. 13-27, 1965
F. Wirt (Govt.)	Denison University	Sept. 20-Oct. 4, 1965
R. Morey	Denison University	Sept. 20-Oct. 4, 1965
*L. Pelekoudas	Antioch College	

*Authors of the programs to be evaluated who were on hand to confer with the evaluators about the programs, pre-and post-tests and evaluation designs.

Appendix B-9

MEMORANDUM

TO: Evaluators of 1964 GLCA Programs FROM: Donald G. Beane, Coordinator

The conference held at Columbus Airport September 9 and 10 clarified some points and resulted in a few changes which we want everyone to observe. Listed below are the items which affect almost every design:

1. Under deisgn #1 the retention test (form #1 used a second time) should be administered at least one week but not more than two weeks after the last discussion period.

2. The Attitude Questionnaire (Teaching-Method Evaluation Questionnaire) will be administered only once in all cases. This should be done as near the end of the experiment as possible. But do not wait until the retention test to give the attitude questionnaire *if* the retention test is scheduled at least a week after the end of the experiment (as in Design #1).

3. If the attitude Questionnaire is given during the same period as a test, the Attitude Questionnaire should be administered first so that the students' reactions to the test will not influence the responses on the questionnaire.

4. All tests supplied by the project and used in more than one design (pre-tests, post-tests, retention tests, final tests) should be administered with a 40 minute time limit. We cannot compare results on a test if one evaluator gives his students 40 minutes, another 45 minutes and perhaps another, 60 minutes. The 40 minute time limit may be shortened for the pre-test since students will not be able to answer many of the questions and consequently will not need as much time.

5. Evaluators using Design #1 are to ask students for written questions which form the basis for subsequent class discussion. These written questions should be forwarded to the coordinator along with the tapes of the class discussion. The evaluators are to give a subjective evaluation of the quality of the questions submitted by students in the two or three groups being compared. The class discussion under design #1 is also to be evaluated for differences in quality between the groups being compared. This evaluation is a part of design #1 only.

6. Following the administration of the post-test in each evaluation study the programed materials are to be collected so that students cannot refer to them during the subsequent class discussions. The programs may be returned to the students when the experiment is completed. Obviously if the post-test completes the experiment, the programs need not be collected.

7. Each evaluator will receive a copy of the IBM print off giving the statistical analysis of the data for his study. Each programer will receive a copy of the statistical analysis of the studies using his program.

8. If the design calls for a section to be divided into two groups, we have asked that the selection be done randomly. If this results in obvious differences in the composition of the two groups which could account for significant differences in achievement on the tests, please explain the situation somewhere on the instructor questionnaire. But do not alter the composition of groups once selected, in an effort to match them on some variable. Differences may also be evident between sections of the same course due to class scheduling, college activities or some other variable unknown to us. Your making notes of these observations will help us account for differences in group performances which are not due to the research design being used. Administer the pre-test as orginally planned.

Appendix B-10

LIST OF FINAL REPORTING CONFERENCE PARTICIPANTS

GLCA College Participants

Albion
- Renato Gonzales
- James Cook
- William Gilbert
- Jean Keller
- Robert Lisenski
- William Cowell

Antioch
- Richard Meisler
- John White
- Don Myatt

GLCA College Participants (cont'd.)

Denison
- George Gilbert
- Samuel Shaff
- Ira London
- William Westbrook
- Thomas Gallant
- Morton Schagrin
- John Morris
- Irvin Wolf

Appendix B-10 (cont'd.)

GLCA College Participants(Cont'd.)

DePauw

Thomas Davis
Garrett Boone
Donald Orlasky
Ray Mizer
William Hanlon
Richard Montgomery
Frank McKenna

Earlham

Robert Brewster
William Stephenson
Alfred Henderson
Daniel Smith

Hope

Philip Crook
Frank Sherburne
Elliot Tanis
Douglas Neckers
Ralph Perry
Philip Van Eyl
Leslie Beach

Kalamazoo

Walter Waring
John Moore

Kenyon

Peter Kidder
Paul Schwartz

Oberlin

Forbes Whiteside

Ohio Wesleyan

Joseph Wetmore
Wendel Patton
Robert Montgomery
Daniel Anderson
Melvin Vulgamore
J. McRee Elrod

GLCA College Participants (Cont'd.)

College of Wooster

James Hawley
Harry Sharp
Dean Garber Drushal
John Baker
Jerry Tovo
Donald Wise
Roy Haynes
Bud Russell
Sam Cho

Task Force Members

Albion	James Cook Jean Keller
Antioch	Richard Meisler John White
Denison	George Gilbert Samuel Shaff
DePauw	Thomas Davis Garrett Boone
Earlham	Daniel Smith William Stephenson
Hope	Elliot Tanis Douglas Neckers
Kalamazoo	Walter Waring John Moore
Kenyon	Paul Schwartz
Oberlin	Forbes Whiteside
O. Wesleyan	Joseph Wetmore Robert Montgomery
Wooster	Don Wise Sam Cho Donald Beane

Appendix B-10 (cont'd.)

LIST OF VISITORS

Professor Algo Henderson
Center for the Study of Higher Education
University of Michigan

Dr. William Deminoff
Commission on Institutional Cooperation

Professor Forbes Robertson
Principia College
Elsah, Illinois

Mr. James Brink
Center for Research on Learning and Teaching
University of Michigan

Dr. Donald Liggett
Associated Colleges of the Midwest

Mr. Kenneth Templeton
Lilly Foundation

Professors John VandenBerg, Dennis Hoekstra, Marion Snapper
Calvin College

Professor Guy Stern
University of Cincinnati

CSS

Robert F. DeHaan, Conference Director
Mrs. Robert DeHaan, Conference Secretary
Prof. Clarence Leuba, Wright College Campus
Prof. Donald Beane, College of Wooster
Dr. Eldon Johnson, President of GLCA

Appendix B-11

AGENDA FOR FINAL REPORTING CONFERENCE

Place: Holiday Inn
Columbus, Ohio
Date: April 29, 1966

Objective of Conference: Report out the results of Project, develop plans for further study and improvement of instruction

Friday, April 29

8:30 a.m.	Registration and program display
9:00 "	Welcome and opening remarks, Robert DeHaan, Project Director
9:15 "	"Evaluation of GLCA Programs," Donald Beane, College of Wooster
10:15 "	Coffee Break
10:30 "	"The Process of Preparing Programs as a Means of Improving Teaching," Clarence Leuba, Visiting Professor, Wright State Campus
11:15 "	Summary of Preliminary Recommendations" and discussion, - Robert DeHaan
12:00 p.m.	Luncheon
1:00 "	"Significance of the Project for the Future," Eldon Johnson, President, Great Lakes Colleges Association
1:30 "	Mixed subgroups to discuss plans and recommendations for further study and improvement of instruction
3:15 "	Coffee Break
3:30 "	College teams to place the ideas generated in mixed subgroups into a priority list. Each college to choose a leader and recorder.
5:00 "	Reporting session. Each college to report on its priority list.
6:00 "	Adjournment of Conference. Each college to leave a set of notes with the conference chairman.
8:00 "	Task force to prepare conference report and formulate a proposal from the ideas developed during the afternoon
	Task force to complete formulation of report and proposal
	Task force adjournment

Appendix C-1

RELATIONSHIP OF ESTIMATED TIME TAKEN TO PREPARE PROGRAMED MATERIAL TO STUDENT TIME WORKING ON PROGRAM

Programer	Estimated Preparation Time(in weeks)40 hr.	Estimated Student Time (in hours)
Arnold	3	---
Brewster	21*	6-7*
Cope	5	---
Cook	27*	4-8*
Davis	45*	8-20*
Elrod	20*	8-16*
Farber	4	---
Kebker	24*	8*
Kidder	3*	6-8*
Leuba	13*	8-10*
Lotowski	34	---
Marshall	23*	30-40*
McKenna	15*	4-5*
Montgomery	36*	2-6*
Pelekoudas	38*	9*
Schagrin	25*	6-7*
Schwartz	63	one month
Smith, et. al.	16	1-6 weeks
Stephenson	17*	12*
Van Eyl	9	--
Wetmore	16	---
Whiteside	15	---
Sum of * items	307	132
Mean times	24 weeks	10 hours

(*) Only figures used in the calculation of the average times. When the student time was given as a range, the midpoint was used.

C-1

Appendix D-1

BIBLIOGRAPHY

(1) Carpenter, C. R. and L. P. Greenhill, Comparative Research on Methods and Media for Presenting Programed Courses in Mathematics and English, The Pennsylvania State University, University Park, Division of Instructional Services.

(2) Della-Piana, Gabriel, M., An Experimental Evaluation of Programed Learning: Motivational Characteristics of the Learner, His Responses, and Certain Learning Outcomes, University of Utah, Department of PSychology, December 1961, Final Report Office of Education Contract SAE 8698, Project No. 864.

(3) Goldstein, L. S. and Gotkin, L. G., A Review of Research: Teaching Machines vs. Programed Textbooks as Presentation Modes, Center for Programed Instruction, New York, 1963.

(4) Green, E. J., Weiss, R. J. and Nice, P. O., The Experimental Use of a Programed Text in a Medical School Course, Journal of Medical Education, Vol. 37, No. 8, August, 1962.

(5) Holland, James G. and Porter, Douglas, The Influence of Repetition of Incorrectly Answered Items in a Teaching-Machine Program (mimeographed, 1960).

(6) Holland, James G., Teaching Machines: An Application of Principles from the Laboratory, Journal of Exp. Anal. of Beh., Vol. 3, No. 4., October 1960, 275-287.

(7) Jensen, Barry T., An Independent-Study Laboratory Using Self-Scoring Tests, Journal of Educational Research, October 1949, 134-137.

(8) Lang, Gerhard and Tohtz, Jack Erwin, Verbal Aptitude and Effectiveness of out-of-class Programed Instruction in Freshman English, Fairleigh Dickinson University, Presented at AERA 1964, Feb. 19-21.

(9) Kormondy, E. J. and Van Atta, E. L., Experiment in Self-Instruction in General Biology, the Ohio Journal of Science 62 (1): 4, January 1962 4-10.

(10) Moore, J. William and Smith, Wendell I., Role of Knowledge of Results in Programed Instruction, Psychological Reports, April 1964, 14, 407-423, Bucknell University.

(11) Roe, Arnold A, A Comparison of Branching Methods for Programed Learning, Journal of Educational Research, Vol. 55, No. 9, June-July, 1962.

Appendix D-1 Cont'd.

(12) Siegel, L. and Siegel, L. C., The Instructional Gestalt: A Conceptual Framework and Design for Educational Research, Audio-Visual Communication Review, Volume Twelve, No. 1, Spring 1964.

(13) Smith, M. Daniel, New Instructional Media: Self-Instruction, Guided Instruction, and the Role of the Teacher, Earlham College, 1962, Final Report, Title VII Project Number 143.

(14) Smith, M. Daniel and Bolyard, A. Joyce, The Interaction of Words and Non-Wordal Stimuli in Programed Sequences of Concept Formation Tasks, Audio-Visual Communication Review (in press).

(15) Smith, Wendell I. and Moore, J. William, Learning Sets in Programed Instruction, Bucknell University, Lewisburg, Penn., March, 1965.

Appendix E-1

POETRY: METHOD AND MEANING

Pre- or Post Test

(Form 1)

I. The following list contains the names of figures of speech often employed by poets:

1. Metaphor
2. Simile
3. Personification
4. Apostrophe
5. Hyperbole
6. Synechdoche
7. Conceit
8. Metonymy

The passages which follow contain one or more examples of each of these figures. By placing the number before the appropriate letter, match the name of the figure with the underlined example.

____A. Love bade me welcome: yet my soul drew back
Guilty of dust and sin,
But quick-eyed Love, observing me grow slack
From my first entrance in,
Drew nearer to me, sweetly questioning
If I lacked anything.

____B. My Shakespeare, rise; I will not lodge thee by
Chaucer or Spenser, or bid Beaumont lie
a little further to make thee a room;
____C. thou art a monument without a tomb....

____D. As bees
In springtime, when the sun with Taurus rides,
pour forth their populous youth about the hive
In clusters.../so thick the airy crowd
swarmed....

____E. She is all states. and all princes, I.
Nothing else is.
Princes do but play us; compared to this,
All honor's mimic, all wealth alchemy.

Appendix D (Cont'd.)

____F. I can love both fair and brown,
Her whom abundance melts, and her whom want betrays,
Her who loves loneness best, and her who mocks and plays,
Her whom the country formed, and whom the town,
Her who still weeps with spongy eyes,
And her who is dry cork, and never cries;
I can love her, and her, and you, and you;
I can love any, so she be not true.

Pre-Test 2

____G. I start out of my sleep to think
Some day I may forget
Their* food and drink;
Or, the house door left unshut,
The hare may run until it's found
The horn's sweet note and tooth of hound.

*pet animals: a hare and a cat.

____H. (The following is a conversation among three kings.)

1st K. "What say you, France?
2nd K. "England, I say nay!"
1st K. "And you, Bohemia?"
3rd K. "Bohemia votes yea!"

II. In your own words, define and give two or three example of literary convention.

Pre Test 3

Pre-Test -- Image and Symbol

1. In your own words, state your concept of an image.

2. What is a tied image?

3. What is a free image?

4. What is a synaesthetic image?

5. How does an image differ from a metaphor?

6. What is a controlling image?

7. What is a symbol?

8. What is the difference between a conventional and an attributive symbol?

Pre-Test 5

1. Analyze this poem in depth for the figures of speech it contains.

2. Develop a multi-level (i.e., literal and symbolic) interpretation of the poem -- an interpretation that is self-consistent and is consistent with the text.

The Mother of God

by

William Butler Yeats

The threefold terror of love; a fallen flare
Through the hollow of an ear;
Wings beating about the room;
The terror of all terrors that I bore
The Heavens in my womb.

Had I not found content among the shows
Every common woman knows,
Chimney corner, garden walk
Or rocky cistern where we tread the
    clothes
And gather all the talk?

What is this flesh I purchased with
    my pains,
The fallen star my milk sustains
This love that makes my heart's blood stop
Or strikes a sudden chill into my bones
And bids my hair stand up?

Appendix E-2

THE LANGUAGE OF LOGIC

Form 1

1. Which of the following is commonly used as a logical symbol?

   A. $<$ B. $\vee$ C. $\triangledown$ D. $|||$

2. Which of the following is not a logical symbol?
   A. $\leftarrow$ B. $\wedge$ C. $\neg$ D. $\leftrightarrow$

3. Select the formula that correctly symbolizes: If the record is cracked then the stylus skips and the sound is not pleasant.

   A. $(R \longrightarrow S) \ v \neg P$
   B. $R \equiv S \ \& \ -P$
   C. $R \supset (S . \sim P)$
   D. $(R \triangledown S) \wedge \leftarrow P$

4. Select the English sentence that correctly interprets: $(F.S.) \ v \sim P$ F: the fever subsides; S: the spots disappear; P: the patient recovers.

   A. If the fever subsides and the spots disappear then the patient recovers.
   B. The patient will recover only if the fever subsides and the spots disappear.
   C. Neither the patient recovers nor does the fever subside or the spots disappear.
   D. Either the fever subsides and the spots disappear, or the patient doesn't recover.

5. Select the formula that correctly symbolizes: If Jones was not lying, he either saw Smith hit Kelly but did not believe Smith's blow was the cause of Kelly's death, or he did not see Smith hit Kelly.

   A. $(-J \rightarrow S) \ \& \ (-B \ v \ -S)$
   B. $\sim J \rightarrow ((S. \sim B) \ v \sim S)$
   C. $-(J \supset ((S \supset -B) \ v \ -S))$
   D. $\sim J \supset (S \wedge \sim B \wedge \sim S)$

6. Find the English sentence that correctly interprets: $(A.B) \supset (FvC)$ A: Able is elected; B: Baker is defeated; C: the city vote was light; F: our fears were unfounded.

   A. If Able is elected and Baker defeated, then either our fears were unfounded or the city vote was light.
   B. If Able is elected then Baker is defeated, and, furthermore, our fears were unfounded and the city vote was light.
   C. Only if Able is elected and Baker defeated will it be the case that our fears were unfounded or else the city vote was light.
   D. If Able is elected then Baker is defeated, or our fears were unfounded and the city vote was light.

7. How many rows would the truth table for this formula have?

$$(p.\ (q \lor \sim s)).(r \supset (\sim p \supset q))$$

A. 6 B. 8 C. 16 D. 24

8. In the truth table for the following formula, how many of the rows have a false (F) entry?

$$p.\ (\sim p \supset q)$$

A. None B. One C. Two D. Three or more

9. Which formula is logically equivalent to: $p.(\sim q \lor \sim p)$

A. $\sim(p \supset q)$ C. $p.(p \supset q)$
B. $p \lor \sim(q.p)$ D. $(p \lor \sim q).(p \lor \sim p)$

10. $p.(q \supset r)$ and $(p.q) \supset (p.r)$ are formulas that are:

A. Logically equivalent C. Equivalent in some cases
B. Contradictory D. None of the above

11. Select the formula that correctly symbolizes: Some hats are green fedoras.

A. $(x)\ (Hx \lor Gx \lor Fx)$ C. $(\exists x)(Hx \supset (Gx\ .\ Fx))$
B. $(\exists x)(Hx\ .\ Gx\ .\ Fx)$ D. $(x)(Hx \supset (Gx\ .\ Fx)$

12. What is the correct interpretation of: $(x)(y)(Px \supset (\sim Kxy \supset \sim Uyx))$ Px: x is a person; Kxy: x knows y; Uxy: x will hurt y

A. A person doesn't always know whom he hurts.
B. One always hurts someone he knows.
C. Some people are hurt if they don't know something.
D. What a person doesn't know won't hurt him.

13 Select the formula that symbolizes: Some Republicans vote against any bill introduced by a Democrat.
Rx: x is a Republican; Bx: x is a bill; Dx: x is a Democrat; Vxy: x votes against y; Ixy: x introduced y

A. $(x)\ [(Rx.Vxy) \qquad (y)(By.(\exists z)(Dz.Izy))]$

B. $(\exists x)[Rx.(y)(By.(\exists z)(Dz.Izy)) \supset Vxy)]$

C. $(\exists x)[Rx.(y)((Vxy.By) \supset (\exists z)(Dz.Iyz))]$

D. $(x)\ [Rx \supset (y)((Vxy \supset By).(z)(Dz \supset Izy))]$

14. Select the sentence that interprets: $(x)\ (y)((Px.Sy.Cxy) \supset Ox)$
Px: x is a person; Sx: x is a psychiatrist; Cxy: x consults y; Ox: x ought to have his head examined

A. A psychiatrist ought to examine the head of anyone who consults him.
B. Anyone who consults a psychiatrist ought to have his head examined.
C. Anyone who ought to have his head examined consults a psychiatrist.
D. If anyone ought to have his head examined he will consult a psychiatrist.

15. Which formula symbolizes a contradiction to: $(x)(Px \supset \sim Sx)$

A. $(x) \sim (Px \supset \sim Sx)$
B. $(x)(Px \supset Sx)$
C. $(\exists x)(Px\ .\ Sx)$
D. $(\exists x) \sim (Px\ .\ Sx)$

16. $(\exists x)(\sim Fx. \sim Gx)$ and $(x)(Fx \vee Gx)$ are:

A. Logically equivalent
B. Contradictory
C. Neither equivalent nor contradictory.
D. Indeterminate until 'F' and 'G' are interpreted.

17. $\sim (x) \sim (Bx\ .\ Rx)$ and $(\exists x)(Bx \supset \sim Rx)$ are:

A. Logically equivalent
B. Contradictory
C. Neither equivalent nor contradictory.
D. Indeterminate until 'B' and 'R' are interpreted.

18. $(x)((Ax.Bx) \supset Cx)$ is logically equivalent to:

A. $(\exists x)(Ax\ .\ Bx.\ Cx)$
B. $(x)\ (Ax \supset Bx) \supset Cx)$
C. $(x)(Ax \supset (Bx \supset Cx))$
D. $(x)(Cx \supset (Ax\ .\ Bx))$

19. If 'Bc' means Cynthia is beautiful, and 'Sc' means Cynthia is smart, what is the meaning of:

$$\hat{x}(Bx \vee Sx)$$

A. Everyone is beautiful or smart.
B. Some girls are beautiful or smart.
C. the class of beautiful or smart things
D. x is beautiful or x is smart

20. Select the correct symbolization of: All the nominees except Ken and John are members of a fraternity.
Nx: x is a nominee; Rx: x is a fraternity; k: ken; j: John; Mxy: x is a member of y

A. $(x)\ [(Nx.\sim((x=j) \vee (x=k)) \supset (\exists y)(Ry.Mxy))]$

B. $(x)\ [(Nx.\sim Nj.\sim Nk) \supset (y)(Ry \supset Mxy)]$

C. $(\exists x)(\exists y)\ [(Nx.Ry) \supset (Mxy \supset \sim((x=j).(x=k)))]$

D. $(\exists x)\ [Nx.\sim(x=j \vee k)\ .\ (y)(Ry \supset Mxy)]$

21. Find the correct symbolization of: There is a moment in every persons's life after which he is no longer naive.
Px: x is a person; Mxy: x is a moment in the life of y;
Nxy: x is naive at time y; Axy: x is after y

A. $(\exists y)(x)((Px\ .\ Myx) \supset (z)(Azy \supset \sim Nxz))$

B. $(\exists y)(x)((Px\ .\ Mxy) \supset (Nxy \supset (\exists z)(Azy \supset \sim Nxz)))$

C. $(x)(\exists y)((Px\ .\ Myx) \supset (\exists z)(Azy\ .\sim Nxz))$

D. $(x)(Px \supset (\exists y)(Myx\ .\ (z)(Azy \supset \sim Nxz)))$

22. Find the correct interpretation of: $(x)(y)((Jx\ .\ Sxy) \supset Ey)$
Jx: x is a junior; Ex: x is a senior; Sxy: x speaks to y

A. Juniors speak only to seniors.
B. Only juniors speak to seniors.
C. Every junior speaks to every senior.
D. All juniors speak to a senior.

23. Find the correct interpretation of: $\sim(\exists x)(y)(x=y)$

A. Nothing is identical with everything.
B. Everything is identical with something.
C. Nothing is identical with something.
D. It is not the case that something is identical with nothing.

24. Find the correct interpretation of: $(y)(y \in \hat{x}Hx \supset y \notin \hat{x}(Wx \vee Bx))$ Hx: x is a horse; Wx: x is white; Bx: x is black

A. The class of horses is not a member of the class of white things.
B. Every horse is not white or black.
C. Any horse in neither white nor black.
D. If anything is a horse it is not white or black.

25. What relationship does j have to k?

$(\exists x)(\exists y)(\exists z)(Pxk.pyx.Pyz.\ Pzj.\ x \neq z\ .\ Mj)$
Pxy: x is a parent of y
Mx: x is male

A. j is a great-grandfather of k
B. j is an uncle of k
C. j is a first cousin of k
D. j is a nephew of k

The Language of Logic

NAME____________________ SCHOOL____________________ GROUP________

DATE______________ INSTRUCTION______________________ FORM________

	A	B	C	D
1.	__	__	__	__
2.	__	__	__	__
3.	__	__	__	__
4.	__	__	__	__
5.	__	__	__	__
6.	__	__	__	__
7.	__	__	__	__
8.	__	__	__	__
9.	__	__	__	__
10.	__	__	__	__
11.	__	__	__	__
12.	__	__	__	__
13.	__	__	__	__
14.	__	__	__	__
15.	__	__	__	__
16.	__	__	__	__
17.	__	__	__	__
18.	__	__	__	__
19.	__	__	__	__
20.	__	__	__	__

INSTRUCTIONS

Place an 'X' on the dash under the letter associated with the correct answer.

If you wish to change your original choice, either erase carefully or place a circle around the INCORRECT choice.

	A	B	C	D
21.	__	__	__	__
22.	__	__	__	__
23.	__	__	__	__
24.	__	__	__	__
25.	__	__	__	__

Appendix E-2 (cont'd.)

LANGUAGE OF LOGIC---ANSWER SHEET

Form 1		Form 2	
1. B	23. A	1. A	23. B
2. A	24. C	2. C	24. C
3. C	25. C *	3. B	25. A
4. D		4. A	
5. B		5. D	
6. A		6. B	
7. C		7. C	
8. C		8. B	
9. A		9. C	
10. A		10. D	
11. B		11. C	
12. D		12. D	
13. B *		13. A *	
14. B		14. C	
15. C		15. D	
16. B		16. C	
17. C		17. A	
18. C		18. B	
19. C		19. C	
20. A		20. A	
21. D		21. B	
22. A		22. D	

ERRATA

Form 1

#13. Answer A should have a $\supset$ between (Vxy) and (y) thus:

$(Rx.Vxy) \supset (y)By.$

Form 2.

#13. Answer A should have another parenthesis after 'Dxy' Thus:

$((Sx \supset Ly.Dxy)).\sim(\exists z)$

Answer B should have 3 right parentheses at the end, thus:

$(Sx \supset Dxy)))$

Form 1 AGAIN!!!

#25. Lower case P is formula should be upper case, Thus:

(Pxk.Pyx.Pyz.Pzj.

Appendix E-3

(last name)	(first name)	(date)	(college)

Evaluation test   Biochemistry for Biologists   Form (1)
Stephenson Sept. 1965

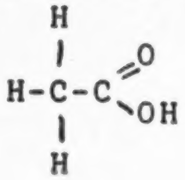
Do the best you can with this test; do not be disturbed if you cannot respond to many items. You should guess whenever you have any basis for doing so.

1. Write the atomic diagram for the magnesium atom (atomic number = 12).

2.. Write the structural formula for ($CH_3CHOHCOOH$).

3. Write the structural formula for sodium acetate. Circle the ionic bond.

acetic acid=



$H-\overset{H}{\underset{H}{C}}-C\begin{smallmatrix}\nearrow O\\ \searrow OH\end{smallmatrix}$

4. Define the "hydrogen bond".

5. Define chemical equilibrium for a reversible reaction.

6. In the reaction sequence

$$\text{phosphoglyceraldehyde + dihydroxyacetone} \rightleftharpoons \text{fructose +}$$
$$\text{phosphoglyceraldehyde} \rightleftharpoons \text{erythrose + xylulose}$$

What effect would an increase in the concentration of dihydroxyacetone have on the concentration of erythrose?
Explain briefly.

7. Write the complete structural formula for glucose.

8. Write the structural formula for a carboxyl (acid) group.

9. Diagram the general structural formula of a tripeptide. Circle each peptide bond.

10. Describe briefly the structure of the α helix.

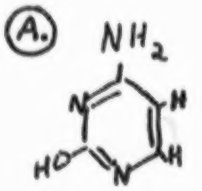
11. Define or explain the primary structure of a protein.

12. What is denaturation (briefly).

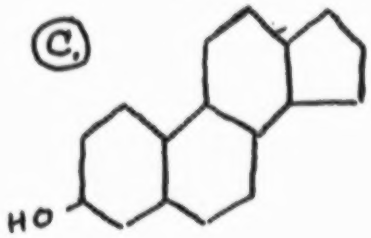
13. Match the following.

____Purine
____Sterol
____Pyrimidine

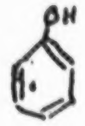
Ⓐ



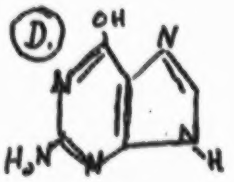
Ⓒ



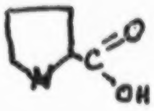
Ⓑ



Ⓓ



Ⓔ



14. List the three constituents of a nucleotide.

15. Construct the DNA strand complementary to this DNA strand.

$$\begin{array}{ccccccccccccccccccccc}
P & - & D & - & P & - & D & - & P & - & D & - & P & - & D & - & P & - & D & - & \text{etc.} \\
 & & | & & & & | & & & & | & & & & | & & & & | & & \\
 & & A & & & & G & & & & T & & & & A & & & & C & &
\end{array}$$

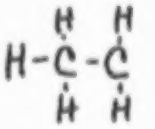
16. What is the pH of a solution?

17. What is a buffer?

18. Match the following:

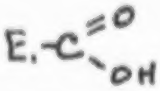
____aldehyde
____aromatic
____ester linkage
____keto
____ethyl

A.



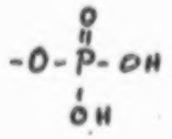
$H-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}$

E.



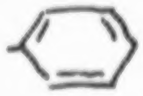
$-C\begin{smallmatrix}=O\\ \diagdown OH\end{smallmatrix}$

I.

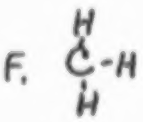


$-O-\underset{OH}{\overset{\overset{O}{\|}}{P}}-OH$

B.



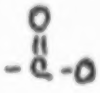
F.



$\overset{H}{\underset{H}{C}}-H$

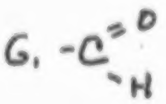
J. $-OH$

C.



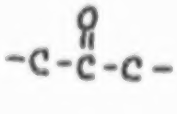
$-\overset{\overset{O}{\|}}{C}-O-$

G.



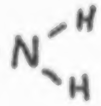
$-C\begin{smallmatrix}=O\\ \diagdown H\end{smallmatrix}$

D.



$-C-\overset{\overset{O}{\|}}{C}-C-$

H.



$-N\begin{smallmatrix}\diagup H\\ \diagdown H\end{smallmatrix}$

19. Write the symbols for calcium ion (atomic no. = 20) and chloride ion (atomic no. = 17).

20. Diagram a hydrogen bond between an $-NH_2$ group and a $-C_{OH}^{=O}$ group.

21. Define a hydrophobic bond.

22. ____Which man first postulated the structure of the α helix.

____Which two men first postulated the helical structure of DNA?

A. Beadle
B. Crick
C. Darwin
D. Linneas
E. Pasteur
F. Pauling
G. Schleiden
H. Watson

23. In the reaction: $AMP + Ph + Cal. \rightleftharpoons ADP + H_2O$

At equilibrium will AMP or ADP be present in the greatest concentration? Explain your answer briefly.

Is the forward reaction endothermic or exothermic?

How many calories does 10 Calories = ?

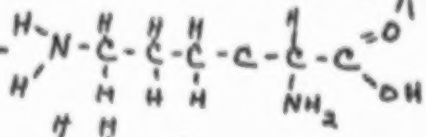
24. What three types of bonding are involved in enzyme - subtrate binding (complexing)?

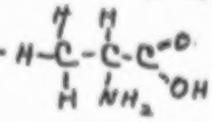
25. Diagram and label the structure of a biological membrance.

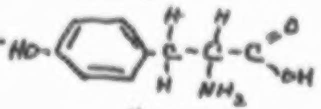
26. Write the general structural formula of a phospholipid.

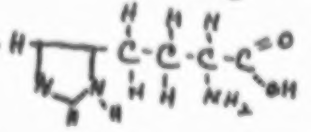
27. Write the structural formula for an ester linkage.

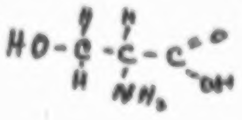
28. To what group (acid, basic, hydroxy, S-containing, etc.) does each of the following amino acids belong?

A. ____________


B. ____________


C. ____________


D. ____________


E. ____________


F. ____________Alanine

G. ____________Cysteine

H. ____________Lysine

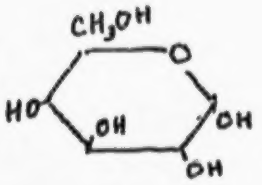
I. ____________Phenylalanine

Appendix E-3 (cont'd.)

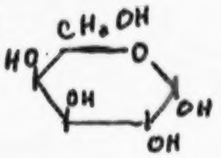
29. Match the following:

____fructose
____ribose
____lactose
____galactose
____maltose
____one molecule with
a β linkage
____any one pentose
____all disaccharides

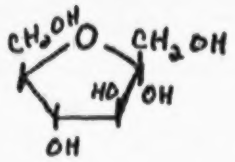
A.


CH₂OH
O
HO
OH
OH
OH

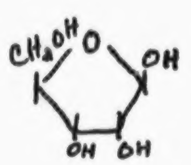
B.


CH₂OH
O
HO
OH
OH
OH

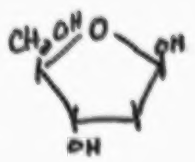
C.


CH₂OH
O
CH₂OH
HO
OH
OH

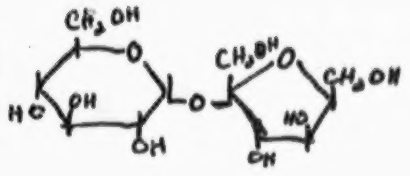
D.


CH₂OH
O
OH
OH
OH

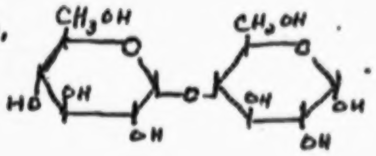
E,


CH₂OH
O
OH
OH

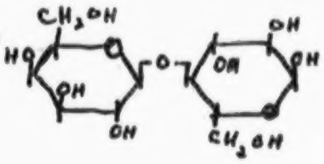
F.


CH₂OH
O
HO
OH
OH
O
CH₂OH
O
CH₂OH
HO
OH

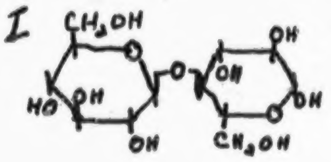
G,


CH₂OH
O
HO
OH
OH
O
CH₂OH
O
OH
OH
OH

H.


CH₂OH
HO
O
OH
OH
O
OH
OH
OH
O
CH₂OH

I


CH₂OH
O
HO
OH
OH
O
OH
OH
OH
O
CH₂OH

Appendix E-4

TEST ON THE LITERARY RELATIONSHIPS AMONG MATTHEW, MARK AND LUKE

Form #1 Choose in each question the answer which is most correct:

1. When one compares in Matthew, Mark and Luke passages which narrate the same event or teaching, one discovers the need of an explanation for (1) while Matthew and Mark occasionally agree exactly, Luke never uses the same words as does Mark. (2) Only once is there agreement between Mark and Luke, although Matthew and Luke sometimes agree. (3) Matthew, Mark, and Luke can agree exactly.

2. When agreement in wording occurs among Matthew, Mark, and Luke, the matter of explaining such agreement (1) becomes difficult since all the Gospels agree on the most important matters as is shown by the unanimous presentation of the last words of Jesus on the cross. (2) is easy since Matthew and Mark state that they are using Luke. (3) becomes relevant since the Gospels do not automatically agree even on such important matters as is seen in their presentation of the last words of Jesus on the cross.

3. Agreement in wording among Matthew, Mark, and Luke can be found (1) not only in the case of important words such as "Christ" or the names of disciples but even in such details as the numbers of loaves and fish in one story. (2) only with such words as one would expect Christian accounts to include. (3) Whenever the sayings of Jesus are uttered to people who live in Athens.

4. One way of discovering which Gospel was used by the other might be a difference in conception about the amount of power which Jesus possessed. (1) If the Gospel assigns relatively more power to Jesus, then that Gospel is earlier and would be the one used by the others. (2) If the Gospel assigns relatively less power to Jesus, then that Gospel is earlier and would be the one used by the others. (3) But close inspection reveals that no difference can be found among the Gospels in their portrayal of the amount of power Jesus possessed.

***** *****

Appendix E-4 (cont'd.)

4. (cont'd.)

Look at the passages immediately below to answer questions 5 and 6.

A	B	C
That evening, at sundown they brought to him all who were sick or possessed with demons. And the whole city was gathered together about the door. And he healed many who were sick with various diseases, and cast out many demons.	Now when the sun was setting, all those who had any that were sick with various diseases brought them to him; and he laid his hands on every one of them and healed them.	That evening they brought to him many who were possessed with demons; and he cast out the spirits with a word and healed all who were sick. This was to fulfill what was spoken by the prophet Isaiah, "he took our infirmities and bore our diseases."

5. The passage which gives Mark's version of the incident is (1) A. (2) B. (3) C

6. The reason why Mark can be selected easily lies in the fact that (1) B is short; thus it is Mark, for Mark is always the briefest of the Gospels. (2) C is Mark's version because it tells how Jesus healed (with a word) (3) A is Mark because Jesus' power to heal is more limited here than in passages B and C.

7. With regard to limitations on Jesus, (1) Matthew, Mark, and Luke agree that only in power is Jesus limited. (2) Matthew, Mark, and Luke do not agree, for Mark and Luke can write of Jesus' declining the adjective "good" while Matthew does not share the rejection of the term. (3) Matthew, Mark, and Luke agree that Jesus was not limited in any way.

***** *****

Look at the passages immediately below in order to answer question 8.

A	B
In those days Jesus came from Nazareth of Galilee and was baptized by John in the Jordan.	Then Jesus came from Galilee to the Jordan to John, to be baptized by him. John would have prevented him, saying "I need to be baptized by you, and do you come to me?" But Jesus answered him, "Let it be so now; for thus it is fitting for us to fulfill all righteousness." Then he consented. (Note: "fulfill all righteousness means "set an example.")

Appendix E-4 (cont'd.)

8. The passage above which gives Mark's version is (1) "A" because in this passage there is no objection to Jesus' being baptized even though this implies a sense of sin. (2) "B" because in this passage the account of Jesus' baptism is expanded, and Matthew, and Luke ordinarily shorten the stories of Mark. (3) "B" because Mark as the earlier Gospel believes that Jesus had no significant limitations. The other Gospels tend to introduce limitations.

9. The material presenting differences in Matthew, Mark, and Luke in the way in which they understand limitations in Jesus encourages me to think that (1) Matthew and Luke use Mark. (2) Matthew and Mark use Luke. (3) Mark and Luke use Matthew.

10. With respect to the sequence of teachings (1) early Christian writings such as the Gospel of Thomas and Matthew, Mark, and Luke present a uniform sequence just as we would expect. (2) such an early Gospel as the Gospel of Thomas agrees with Mark, but as a rule Matthew, Mark, and Luke cannot agree as to the succession of particular teachings of Jesus. (3) there seems to be no particular sequence of teachings to which Gospels such as the Gospel of Thomas and Mark agree.

11. With respect to the succession of events, early Christian writings (1) do not agree either. (2) agree just as they present a uniform sequence of teachings from the career of Jesus. (3) generally agree only after the trip of Jesus to Damascus for the purpose of rescuing the good Samaritan from the Woman at the Well.

12. When Matthew and Mark are compared with John as to the sequence of events with respect to such an important event as Jesus' driving the money-changers out of the Temple, (1) these three Gospels agree in the placing of the driving the money-changers out of the Temple. (2) there is not complete agreement among the three but the difference is unimportant because they all place the event in the last week of Jesus' life. (3) these Gospels do not agree, for one places the event early in Jesus' career and the other two place it among the last events of Jesus' life.

13. With repect to the succession of events in Jesus' career, the accounts in Matthew, Mark, and Luke (1) never agree. (2) sometimes agree exactly, (3) agree all of the time.

14. With respect to the succession of teachings in Jesus' career, the accounts in Matthew, Mark, and Luke (1) never agree, (2) sometimes agree exactly. (3) agree all of the time.

* * * * * * *   * * * * * * *

Appendix E-4 (cont'd.)

Look at the materials below in order to answer question 15.

A	B	C
Saying about new wine in old wine skins.	Blasphemy against the Holy Spirit is unforgiveable.	Saying about new wine in old wine skins.
Blasphemy against the Holy Spirit is unforgiveable.	Saying about new wine in old wine skins.	Blasphemy against the Holy Spirit is unforgiveable.
Those who do the will of God are described as Jesus' mother and brothers.	Allegory of the wicked tenants.	Those who do the will of God are described as Jesus' mother and brothers.
The allegory of the wicked tenants.	Those who do the will of God are described as Jesus' brothers and mother.	The allegory of the wicked tenants.
The question of paying taxes to Caesar.	The question of paying taxes to Caesar.	The question of paying taxes to Caesar.

15. By looking at the sequence of materials in each column, it is possible to say that Matthew (1) has to be in column "B" because Matthew never agrees with Mark in the sequence of sayings even though he agrees on the sequence of events. (2) could be either "A" or "B", if Mark is "C" because Matthew ordinarily does not agree with Mark in the sequence of materials, but there is just one case of agreement between the two. (3) could be "A" or "C" because Matthew and Mark often agree in their sequences of material.

*****

*****

16. If we were to try to answer which Gospel is being used by the others and tried to employ conclusions from the sequence of materials in each Gospel we would find that (1) Matthew, Mark, and Luke differ enough in their sequences to give us some deductions about which one was being used by the others. (2) Matthew, Mark, and Luke always agree as we would expect them to so that we cannot discover from the matter of sequence which Gospel is used by the others. (3) Matthew, Mark, and Luke disagree so much that it is impossible to conclude anything.

Appendix E-4(Cont'd.)

17. When the events of the "Last Supper" are studied we found that (1) Mark and Luke agree exactly on the succesion of the bread and wine, as we would expect them to. (2) Luke does not mention the "Last Supper" but Mark does. (3) Mark and Luke do not agree on the sequence of the uses of bread and wine.

18. When we describe the relations of Matthew, Mark, and Luke to each other so far as their handling of the sequence of events and teachings is concerned, we can generalize by saying that (1) when Matthew and Mark agree in sequence, Luke disagrees; and when Luke and Mark agree in sequence, Matthew disagrees. (2) when Matthew and Mark disagree in sequence, Luke agrees with Mark and when Luke and Mark disagree in sequence, Matthew agrees with Mark. (3) when Matthew and Luke agree in sequence Mark disagrees; and when Matthew and Luke disagree in sequence, Mark agrees.

19. Observations on sequence of material encourage us to say that (1) Mark uses Luke's sequence sometimes, and he uses Matthew's sequence at other times. (2) Luke uses Matthew's sequence sometimes, and he uses Mark's sequence at other times. (3) Matthew and Luke are using Mark's sequence.

****** ******

Consult the exhibit on the opposite page in order to answer questions 20 and 21.

20. The column which gives Mark's sequence is (1) 1. (2) 2. (3) 3.

21. The reason why the particular column is to be identified as giving Mark's sequence lies in the fact that (1) the first column starting with the parable of the sower and ending with the interpretation of the parable contains the items given in columns 2 and 3 with only one exception. (2) the second column starting with the accusation against Jesus and ending with the interpretation of the parable of the sower has the items found in the first and third columns with only one exception. After all the Gospels of Matthew, Mark, and Luke are not identical. (3) when column 2 does not agree with the sequence of the third column, column 1 does agree; and when column 1 does not agree with the sequence in the third column, column 2 does agree; so column three is Mark.

****** ******

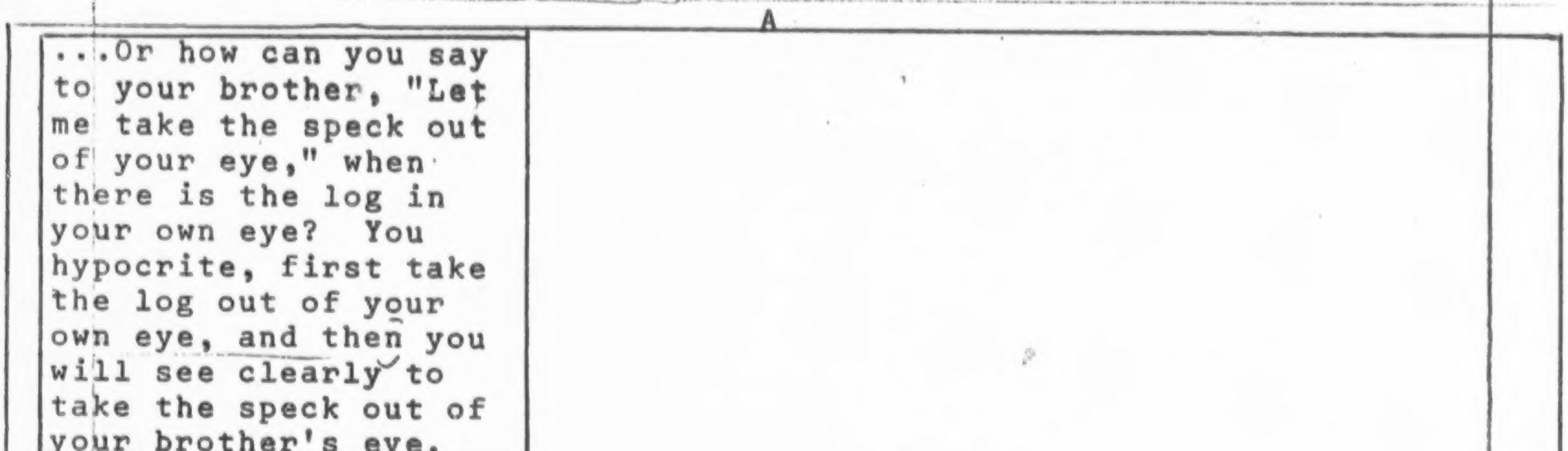
22. Once we pass beyond the agreement which is found among Matthew, Mark, and Luke (1) there is a significant agreement in wording between Matthew and Luke in material not found in Mark. (2) there is no significant agreement between Matthew and Luke. (3) there is a significant agreement in wording and in sequence between Matthew and Luke in material not found in Mark.

Appendix E-4 (cont'd.)

23. Several explanations can be formulated to cover the data revealed in comparing non-Markan material in Matthew and Luke. (1) It hardly seems possible that Matthew and Luke were writing about the same figure. (2) Matthew and Luke are writing about the same figure, but they are portraying very different periods of the life of Jesus. One Gospel, for example, is concerned only with the last week of Jesus' life. (3) Matthew and Luke may have copied a source unknown to us.

24. A significant fact which appears when one studies the sequences of non-Markan teachings in Matthew and Luke is that (1) Matthew and Luke never agree on placing the same non-Markan teaching in the sequence of Mark. (2) Matthew and Luke never agree on placing teachings in the sequence of Mark because Matthew and Luke do not share any teachings beyond the material they share with Mark. (3) Matthew and Luke occasionally agree on placing the same non-Markan teaching in the sequence of Mark.

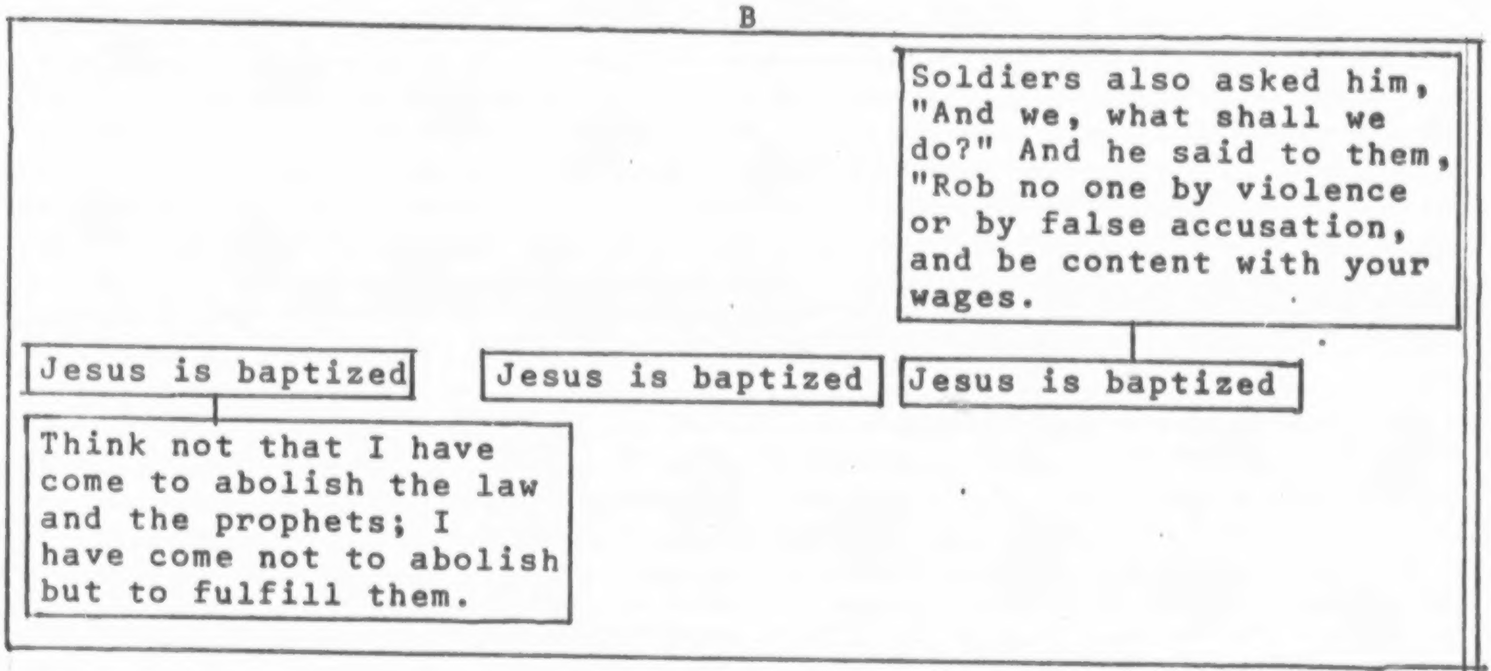
A



...Or how can you say to your brother, "Let me take the speck out of your eye," when there is the log in your own eye? You hypocrite, first take the log out of your own eye, and then you will see clearly to take the speck out of your brother's eye.		
The healing of a leper	The healing of a leper	The healing of a leper
The choosing of the 12	The choosing of the 12	The choosing of the 12.
		...Or how can you say to your brother, "Brother, let me take out the speck that is in your eye, "when you yourself do not see the log that is in your own eye? You hypocrite, first take the log out of your own eye, and then you will see clearly to take out the speck that is in your brother's eye.

Appendix E-4 (cont'd.

B



Soldiers also asked him, "And we, what shall we do?" And he said to them, "Rob no one by violence or by false accusation, and be content with your wages.

Jesus is baptized

Jesus is baptized

Jesus is baptized

Think not that I have come to abolish the law and the prophets; I have come not to abolish but to fulfill them.

Consult the exhibit on the opposite page and above in order to answer questions 25 and 26.

25. The exhibit which has nothing to do with "Q": (1) B as it stands. (2) B if the Markan material is eliminated. (3) A as it stands.

26. The evidence on the opposite page and above shows why the theory of "Q" is accepted in that (1) according to exhibit B the same theme does not appear in Matthew as appears in Luke. (2) the materials of exhibits A and B show that Matthew and Luke agree in placing the same saying at the same point in the Markan outline. (3) the exhibit displays the fact that Matthew and Luke do not agree on the placing of the same saying at the same point in the Markan outline or sequence.

27. When the non-Markan sayings common to Matthew and Luke are examined, it is discovered that in the presentation of stresses, such as the attitude of Jesus toward poverty, (1) it is Matthew who portrays Jesus consistently but Luke is inconsistent in his presentation of a particular stress. (2) it is Luke who portrays Jesus consistently but Matthew is inconsistent in his presentation of a particular stress. (3) neither Matthew nor Luke is consistent in the presentation of a particular stress.

28. First, the placing of non-Markan sayings common to Matthew and Luke in the sequence of Mark, and, secondly, the issue of the consistency with which a stress is presented were the grounds on which the theory rests that says (1) Matthew and Luke used a

22

Appendix E-4 (Cont'd.)

source unknown to us. (2) Matthew used Luke in addition to Mark. (3) Luke used Matthew in addition to Mark.

29. "Q" may be identified as (1) the material in Matthew and Luke remaining after Mark's material and the non-Markan material common to Matthew and Luke are removed. (2) the unknown source which Matthew and Luke used in addition to Mark. (3) the Markan material which Matthew and Luke did not use.

Essay Question No. 1

Using all evidence you can remember, give in detail the reasons why literary analysis of Matthew, Mark and Luke gives rise to the theory that Mark was the earliest of the three Gospels.

Essay Question No. 2

Using the evidence you can remember, give in detail the reasons why a second unknown source is thought to have been used by Matthew and Luke in addition to their use of Mark.

Appendix E-5

Systematic Analysis in
Political Science

FORM I

1. In each of the following pairs, circle the letter before that item which you believe to be a political inquiry.

   a. The structure of the Ohio Republican Party, from precinct to chairman.
   b. Factors operating to decentralize the Republican State Chairman's power.

   a. Membership of the General Assembly of the United Nations.
   b. Influence of the Afro-Asian bloc in General Assembly voting.

   a. The appropriate role of the press in reporting pre-trial events in criminal cases.
   b. Coverage of the 1964 Presidential election by the Chicago Tribune and New York Times.

2. Which of the following rephrasings or uses of the title, "The Presidium of the Communist Party (CP) of the USSR" is a political inquiry? Circle the letter before the correct answer.

   a. Influence of the military upon the Presidium of the CP.
   b. Strategies of the Presidium of the CP in the face of Chinese objections to Soviet foreign policy.
   c. The uses of ideology by the Presidium of the CP in adjusting to conditions unforeseen by Marx and Lenin.
   d. All of these.
   e. None of these.

3. Some statements, dealing with facts, are called "descriptive," while others, dealing with values, are termed "normative." Place a D for descriptive or an N for normative before each of the following:

   ___a. Human nature basically rests upon self-interest.
   ___b. Men everywhere, despite cultural differences, are pretty much the same.
   ___c. Men naturally seek to be free and independent.
   ___d. War is inevitable, so the function of diplomacy is to stretch the time between wars.

4. "Ends" in men's lives, once obtained, may become "means" to yet higher "ends." Thus, a "means" may be regarded in Dewey's terms as "ends-in-view." In the following, place a 1 besides the least high ends-means, which leads to the next highest (place a 2), and so on, to complete the sequence.

Appendix E-5 (cont'd.)

4. (cont'd.)

___a. A two-party system with competing programs and candidates.
___b. Individualism, or the ability to live one's life as he sees fit.
___c. Right to vote.
___d. Responsibility of public officials for their use of power.

5. Examine closely the following words and terms. Then, select one of these to complete the next series of statements. Not all are usable, and some may be used more than once.

fact
descriptive
significance
government
intermediate goals
prescriptive

empirical
method
polity
efficient
problem
value

normative
relevance
means-end chain
hierarchy
state
scope

a. Political inquiry begins where there is a ________________ to consider.
b. Political science tends to be narrow in ________________ if the focus of inquiry is merely upon the study of the ________________.
c. Political inquiry must contribute meaningfully to our understanding of the subject--that is, it must have ______________,.
d. In any scholarly discipline, there develops a ______________, a set of systematic procedures for learning the truth.
e. An object of study which may be verified by observation is called a ______________, and statements about it are called ________________ statements.
f. If the object of study deals with an assumed ______________, we call statements about it ________________ statements.
g. A statement in the form, "If you think A is a good end, then in order to realize it you must use means B, "is called a ________________ statement.
h. A statement in the form, "End A is a good thing," is a ______________ statement.
i. A statement in the form, "A has two branches of government," is a ________________ statement.
j. Preferential ranking of ______________ produces a means-end chain.
k. Political science viewed as focus on the ____________ as object of study may emphasize legal and philosophical abstractions.

5. (cont'd.)

   l. "What is the nature of the good society?" is not an inquiry that is ________________ or ________________, but one that is ________________.

   m. One type of inquiry for political scientists is determining how to achieve a given end with minimum cost; this kind of inquiry deals with the question of what is ________________.

6. "The Presidential vote from 1944 to 1964 in the center city, suburbs, and non-metropolitan areas of the U.S." are data. Pose an empirical, prescriptive, and normative inquiry about them in one sentence each:

   a. Empirical:

   b. Prescriptive:

   c. Normative:

7. In scientific methodology, whether in the natural or social sciences, the terms "theory," assumption," and "hypothesis" are often used. In your own words, define them (one sentence each):

   a. Theory:

   b. Assumption:

   c. Hypothesis:

8. Theory generates testable ________________, it helps to ________________ existing facts or events, and if valid, it may be used to ________________ future events.

9. Indicate whether each of the following is a theory, assumption, or hypothesis by placing to the left of the item a T, A or H.

   ___a. In international relations, nation-states are motivated purely by considerations of their national interest.

   ___b. States seek to achieve power which is a least, and no less than, that of other states.

   ___c. Failure of a state to signal clearly to other states its intentions or policies works against the achievements of those policies.

   ___d. Strong support given by a population for its leaders' foreign policies tends to make difficult any efforts by the leaders to change those policies.

   ___e. War is an expression of man's state of sin.

10. In political science there are three major "approaches:"

___a. Institutional--i.e., study of stable patterns of group behavior.
___b. Philosophical--i.e., ethics, values, etc. as the central concern.
___c. Behavioral--i.e., analysis of interactions of individuals.

Place a 1 before the approach you believe is the oldest, a 3 before the newest, and a 2 before the approach of intermediate age.

11. Determine which of the three approaches briefly defined in #10 is most appropriately associated with each of the following (place an I, P or B before each item).

___a. Analysis of the liberal and conservative members on the Supreme Court on the question of a defendant's rights in a criminal trial.
___b. Analysis of the rights of a defendant in a criminal case as defined by the written opinions of the Supreme Court.
___c. Analysis of the proper balance between the rights of a defendant and the rights of the community to protection and order.

___d. Associated with internal consistency.
___e. Associated with systematic description of formal structures leading to generalizations.
___f. Associated with emphasis upon reliable methodology.

Most characteristically would deal with:
___g. "Render unto Caesar that which is Caesar's and unto God that which is God's.
___h. Voter motivations in the 1964 election.
___i. A high school civics textbook.

Most characterictic weakness would be:
___j. Tends to omit description of structures.
___k. Fails to relate ideal to real behavior.
___l. Although descriptive, fails to account for the individual's actions.

12. Three "theories" important in political science today are:
a. Power Theory: explains a relationship among persons in which one person induces another to act differently from his normal pattern of behavior.

12. (cont'd.)

b. Group Theory: explains politics as a process resulting from the conflict of human organizations.
c. Decision-Making Theory: explains how a choice of action is determined.

Estimate for which theory the statements below are most appropriate and place an a, b, or c to the left of each. Some statements are appropriate for more than one theory; indicate this by placing more than one letter in the space provided.

___a. Deals with a quality characterized as having the threat of sanctions.
___b. Incomplete as a theory and appropriate for some problems but not for others.
___c. Studies "elites"--i.e., a minority whose views seem to prevail in most situations where conflict exists.
___d. More than the others deals with a "process"--i.e., movement, activity, relationship among events and actors.
___e. The hypotheses it generates are not fully testable or always significant.
___f. Usually focuses upon a relationship traditionally recognized as central in the political process.
___g. Its central concept may be defined as shared attitudes on the basis of which certain claims are made on others having different attitudes.
___h. May employ simulation devices, such as game theory.
___i. Utilizes the case study as a technique of analysis, although this technique lends itself poorly to generalization.
___j. Would deal with such subjects as an active minority, overlapping membership, cohesion, and access to public officials.
___k. Deals with such terms as "influence" and "authority."
___l. Would best be employed in studying a lobby organization.

Appendix E-76

Table I

Student Data Roster (Do not distribute to students)
and Teaching-Method Evaluation Questionnaire

The following information about each student should be filled in completely. In order to evaluate the results of the various design experiments with each other, the personal student data is absolutely necessary. All information on this sheet will be kept in strictest confidence. Please print.

Design Data (Card No. 1)

Program Title ____________________ (cc 1)

Evaluator's Name ____________________ (cc 2)

Design Number ____________________ (cc 3)

Group Number ____________________ (cc 4)

Student's Name ____________________ (cc 5-20)
Last Name First

Sex ________ ________ (cc 21) Class ____________ (cc 22)

CEEB Scores

Math __________ (cc 23-25) Verbal __________ (cc 26-28)

Test Form 2 (Pre Test) ____________________ (cc 29-31)

Text Form 2 (Post Test) ____________________ (cc 32-34)

Test Form 1-B (Final or Retention Test ____________________ (cc 35-37)

Content test No. 1)
Content test No. 2) (English only) ____________________ (cc 38-39)

Rank in high school graduating class ____________________ (cc 42-44)

Size of high school graduating class ____________________ (cc 45-47)

Cumulative GPA in college (omit if
student if a beginning freshman) ____________________ (cc 48-50)

App E-6 (cont)

Teaching-Method Evaluation Questionnaire (Card No. 2)
(To be filled in by student)

As you may know, you have been participating in a study of the effectiveness of various methods of presenting subject matter to students. Will you kindly give your reactions to the methods used in your course or section? This questionnaire is to be used for research purposes only and will not affect your grade. Please print.

1. Student Name__________________________(cc 5-29) Class__________________________
Last Name First

Course______________________ Instructor______________ College________________

2. Estimate to the nearest hour the total amount of time you spent outside of class during the experiment in this course. Itemize the time into these categories:

______________________ Working on programed material (cc 23-24)

______________________ Reading text material and/or working assigned problems (cc 25-26)

______________________ Reviewing (cc 27-28)

3. During this experiment, what materials and/or methods were used to present subject matter to you? Check one or more categories below:

_________________ Programed Material (cc 29) ________Lectures (cc 31)
_________________Text Material (cc 30) ________Discussion (cc 32)

4. To the left below you will see four columns headed by the words programed material, text material, etc. On the right below are five evaluative statements in line with the blank spaces in the columns. Place a check in the column under each method or materials you used in line with the statement on the right that best fits your evaluation of it, omitting columns that do not apply to you. You may use the same evaluative statement for more than one method if you need to.

Programed Material	Text Material	Lectures	Discussion	
______	______	______	______	Very positive learning experience (1)
______	______	______	______	More positive than negative (2)
______	______	______	______	Indifferent, no strong reaction (3)
______	______	______	______	More Negative than positive (4)
______	______	______	______	Very poor learning experience (5)

5. Evaluate the pace or the rate at which new information was presented to you by each of the methods or materials listed in the columns below on the left.

Programed Material (cc 37)	Text Material (cc 38)	Lecture (22 39)	Discussion (cc 40)	
______	______	______	______	The pace was too fast (1)
______	______	______	______	The pace was about right most of the time(2)
______	______	______	______	The pace was too slow(3)
______	______	______	______	The pace was uneven (4)

App E-6 (cont)

6. Did you have a sense of direction, a feeling of getting some place,

Programed Material (cc 41)	Text Material (cc 42)	Lecture (cc 43)	Discussion (cc 44)	
				Yes, I was never in doubt (1)
				Most of the time (2)
				Sometimes (3)
				Usually not (4)
				No, I was lost most of the time (5)

7. Could you review the material easily?

Programed Material (cc 45)	Text Material (cc 46)	Lecture (cc 47)	Discussion (cc 48)	
				Very easy to review (1)
				Fairly easy to review (2)
				Fairly / Difficult to review (3)
				Very difficult to review (4)
				Did not review (5)

8. Rank the following methods of being presented with information or subject matter according to your preference. Give the rank of 1 to your highest preference, 2 to your next highest, etc., until you have ranked all methods you used in this study.

____________ Programed Material (cc 49)

____________ Text Material (cc 50)

____________ Lecture (cc 51)

____________ Discussion (cc 52)

9. How did you feel, in general, about the subject matter covered in this course before this experiment? (cc 53)

____________ My most like subject (1)
____________ I liked the subject better than some others (2)
____________ No strong reaction for or against the subject (3)
____________ I disliked the subject more than many other subjects (4)
____________ My least liked subject (5)

10. How have the methods used in the experiment affected your attitude toward this subject?

Programed Material (cc 54)	Text Material (cc 55)	Lecture (cc 56)	Discussion (cc 57)	
				Favorably (1)
				No appreciable effect (2)
				Unfavorably (3)

11. Below are four pairs of opposite words with five spaces between. You are to evaluate the methods used in your group for this experiment. Indicate your attitude by checking in the appropriate space between each of the four pairs of opposite words. A check to the far left would indicate you thought it was boring. A check at the extreme right would indicate you thought it was stimulating. A check in the second space from the right would indicate you thought it somewhat stimulating, etc. Evaluate all the methods in which you participated.

Programed Material

Boring _____ _____ _____ _____ _____ Stimulating (cc 58)
Too hard _____ _____ _____ _____ _____ Too easy (cc 59)
Efficient _____ _____ _____ _____ _____ Inefficient (cc 60)
Delightful _____ _____ _____ _____ _____ Irritating (cc 61)

Text Material

Boring _____ _____ _____ _____ _____ Stimulating (cc 62)
Too hard _____ _____ _____ _____ _____ Too easy (cc 63)
Efficient _____ _____ _____ _____ _____ Inefficient (cc 64)
Delightful _____ _____ _____ _____ _____ Irritating (cc 65)

Lecture

Boring _____ _____ _____ _____ _____ Stimulating (cc 66)
Too hard _____ _____ _____ _____ _____ Too easy (cc 67)
Efficient _____ _____ _____ _____ _____ Inefficient (cc 68)
Delightful _____ _____ _____ _____ _____ Irritating (cc 69)

Discussion

Boring _____ _____ _____ _____ _____ Stimulating (cc 70)
Too hard _____ _____ _____ _____ _____ Too easy (cc 71)
Efficient _____ _____ _____ _____ _____ Inefficient (cc 72)
Delightful _____ _____ _____ _____ _____ Irritating (cc 73)

12. Have you ever used programed material before this time ____Yes ____No (cc 74)

Where did you use it? (cc 75)________In junior High School (1)
________In Senior High School (2)
________In College (3)
________At Home (4)

What subject matter was covered by programed materials?______________________

____

~~App E-7~~

APPENDIX E-7

Table 1 Composite Student Attitudes for all Students

Variable*	Statistic	Program	Text	Lecture	Discussion
Q4 Positive Evaluation	Mean Rank**	1.95	2.33	1.86	2.15
	N	831	328	602	769
Q5 Pace	Mean Rank***	2.10	2.13	1.98	2.21
	N	831	311	603	722
Q6 Direction	Mean Rank**	2.20	2.38	2.10	2.44
	N	832	321	601	738
Q7 Review	Mean Rank**	2.14	2.31	2.04	2.92
	N	828	325	598	670

*See [redacted] Appendix [redacted] E-6 for exact wording of Questions 4, 5, 6, 7.

**The lower the numerical mean rank on these questions, the more favorable was the rating; 3 was the midpoint of the scale.

***A response of 1 indicated the pace was too fast.
A response of 2 indicated the pace was about right.
A response of 3 indicated the pace was too slow.
A response of 4 indicated the pace was uneven.

Table 2 Student Attitudes toward Poetry Unit

Variable	Statistic	Program	Text	Lecture	Discussion
Learning	Mean Rank	2.14	2.16	1.79	1.80
	N	152	99	131	124
Pace	Mean Rank	2.02	2.10	2.18	2.19
	N	153	93	128	118
Direction	Mean Rank	2.22	2.31	2.00	2.14
	N	153	95	129	123
Review	Mean Rank	1.81	2.02	2.00	2.53
	N	152	96	128	119

Table 3 Student Attitudes toward Logic Unit

Variable	Statistic	Program	Text	Lecture	Discussion
Learning	Mean Rank	1.91	2.36	2.11	2.38
	N	199	81	89	139
Pace	Mean Rank	2.35	2.20	1.98	2.33
	N	198	79	92	114
Direction	Mean Rank	2.21	2.35	2.24	2.62
	N	198	81	90	117
Review	Mean Rank	2.67	2.54	2.49	3.36
	N	198	80	86	90

Table 4 Student Attitudes Toward Biochemistry Unit

Variable	Statistic	Program	Text	Lecture	Discussion
Learning	Mean Rank	1.86	2.66	1.90	2.36
	N	217	100	179	294
Pace	Mean Rank	1.81	2.15	1.86	2.11
	N	218	95	179	284
Direction	Mean Rank	2.28	2.67	2.22	2.54
	N	218	99	178	287
Review	Mean Rank	2.18	2.63	2.15	2.76
	N	216	103	179	269

Table 5 Student Attitudes Toward Religion Unit

Variable	Statistic	Program	Text	Lecture	Discussion
Learning	Mean Rank	1.77	1.95	1.70	1.82
	N	155	40	132	142
Pace	Mean Rank	2.31	2.05	1.98	2.24
	N	155	37	133	138
Direction	Mean Rank	1.87	1.89	1.90	2.33
	N	155	38	132	141
Review	Mean Rank	1.64	1.79	1.65	3.19
	N	155	39	133	128

Table 6 Student Attitude Toward Political Science Unit

Variable	Statistic	Program	Lecture	Discussion
Learning	Mean Rank	2.21	1.92	2.10
	N	108	71	70
Pace	Mean Rank	2.01	1.92	2.41
	N	107	71	68
Direction	Mean Rank	2.44	2.21	2.49
	N	108	72	70
Review	Mean Rank	2.24	1.99	3.14
	N	107	72	64

Appendix E-8

Tables for Individual Studies

EXPLANATION OF THE ANALYSIS OF VARIANCE

The analysis of variance is based on repeated measures on the same subjects (pre and post test scores) In analyzing the studies under Design #2 three measures were compared on each subject: pre, post, and final test scores. This was done because the differences in methods of instruction under Design #2 took place between the post tests and the final tests.

The columns headed source: source of the variability in the test score; SS: sums of squares; df: degrees of freedom; MS: mean squares; and F: f-ratio are all used in the computation of the final f-ratio. The F statistic in the row labeled "Learning" indicates ~~if~~ whether or not there is a significant difference in the mean~~s~~ scores on pre tests and post tests which can be used as a basis for concluding that learning has taken place. The f-ratio in the row labeled "Groups" indicates if there is any significant difference in the amount of learning due to the difference in methods of instruction that the groups received. The final f-ratio in the row labeled "Interaction" indicates whether or not there was a significant difference in the rate of learning of the groups being compared.

APPENDIX E-8

[redacted]

Study 1: Mizer-Johnson - Design #1

Table 1a-Means and Standard Deviations

Group		Pretest	Posttest
Program	M	31.92	73.75
	SD	11.37	11.80
	N	24	
Lecture	M	18.19	56.46
	SD	11.33	16.35
	N	26	

Table 1b- Analysis of Variance - Program Group - Mizer

[redacted]

Source	SS	df	MS	F
Between Subjects	4,426.67	23		
Within Subjects	22,748.00	24		
Learning(Pre-Post)	21,000.34	1	21,000.34	276.36***
Residual	1,747.66	23	75.99	
Total	27,174.67	47		

Table 1c - Lecture Group - Johnson

Source	SS	df	MS	F
Between Subjects	5,519.98	23		
Within Subjects	22,586.50	24		
Learning(Pre-Post)	19,723.52	1	19,723.52	158.45***
Residual	2,862.98	23	124.48	
Total	28,106.48	47		

***P< .001

App. E-8 (cont)

Study 2: (Church - Design #1)

Table 2a-Means and Deviations

Group		Pretest	Posttest
Program	M	20.83	69.88
	SD	13.18	13.09
	N	24	
Lecture	M	25.13	72.39
	SD	16.06	7.88
	N	23	

Table 2b - Analysis of Variance

Source	df	MS	F
Between Subjects			
Groups	1.0	272.64	1.46
Error Between	44.9	187.29	
Within Subjects			
Learning(Pre-Post)	1.0	54461.14	383.27***
Interaction	1.0	18.60	.13
Tests*XSs w/in gps	44.9	142.10	
Total	92.9		

Study 3: Judd and Weis - Design #1

Table 3a - Means and Standard Deviation

Group		Pretest	Posttest
Program	M	59.45	68.91
	SD	7.85	22.06
	N	11	
Lecture	M	55.50	69.17
	SD	13.54	9.16
	N	12	

Table 3b - Analysis of Variance

Source	df	MS	F
Between Subjects			
Groups	1.0	39.22	.17
Error Between	20.9	236.62	
Within Subjects			
Learning (Pre-Post)	1.0	1534.05	8.91**
Interaction	1.0	50.92	.30
Tests XS s w/in gps.	20.9	172.12	
Total	44.9		

$*p < .05$ $**p < .01$ $***p < .001$

App E-8(cont)

Study 4: Burkett - Design #2

Table 4a - Means of Groups

Group		Pretest-T_1	Posttest-T_2	Final Test-T_3
Program-Discussion	M	19.91	55.36	50.95
	N	22		
Program-Lecture	M	23.37	44.42	43.37
	N	19		

Table 4b - Analysis of Variance

Source	SS	df	MS	F
Between Subjects	14,197.02	40		
Groups	470.45	1	470.45	1.34
Error Between	13,726.57	39	351.96	
Within Subjects	35,606.00	82		
tests	22,473.25	2	11,236.63	70.37***
interaction	677.20	2	338.60	2.12
tests XSs w/in gps	12,455.55	78	159.69	
Total	49,803.02	122		

Individual comparisons

Differences between $T_1 - T_2$ and $T_1 - T_3$ are significant.

Difference between $T_2 - T_3$ is not significant.

$T_1 = 21.17$ $T_2 = 52.44$ $T_3 = 47.44$

*$P < .05$ **$P < .01$ ***$P < .001$

Study 5: Boyle - Design #3

Table 5a - Means and Standard Deviations

Group		Pretest	Posttest
Program-Lecture	M	15.53	29.37
	SD	6.45	6.22
	N	30	
Lecture-Program	M	17.74	29.26
	SD	5.47	9.17
	N	23	

Table 5b - Analysis of Variance

Source	df	MS	F
Between Subjects			
Groups	1.0	28.71	.39
Error Between	50.0	74.00	
Within Subjects			
Learning(Pre-Post)	1.0	4,184.78	107.66***
Interaction	1.0		.90
Tests XSs w/in gps	50.0		
Total	103.1		

*$P < .05$ **$P < .01$ ***$P < .001$

App E-8 (cont)

Study 6: Anderson - Design #1

Table 6a - Means and Standard Deviations

Group		Pretest	Posttest
Program	M	3.84	43.36
	SD	8.32	18.25
Text	M	4.77	42.33
	SD	6.03	15.93
	N	29	

Table 6b - Analysis of Variance

Source	df	MS	F
Between Subjects			
Groups	1.0	.07	.00
Error Between	52.5	205.02	
Within Subjects			
Learning (Pre-Post)	1.0	40516.05	268.35***
Interaction	1.0	25.01	.17
Tests XSs w/in gps.	52.5	150.93	
Total	108.0		

Study 7: Angell - Design #1

Table 7a - Means and Standard Deviations

Group		Pretest	Posttest
Program	M	10.26	57.17
	SD	11.16	17.06
	N	23	
Text	M	9.58	49.74
	SD	14.65	11.51
	N	19	

Table 7b - Analysis of Variance

Source	df	MS	F
Between Subjects			
Groups	1.0	342.94	1.28
Error Between	39.6	267.37	
Within Subjects			
Learning (Pre-Post)	1.0	39441.05	207.09***
Interaction	1.0	237.41	1.25
Tests XSs w/in Gps.	40.7	190.45	
Total	82.2		

*P < .05 **P < .01 ***P < .001

App E-8(cont)

Study 8: Van Eyl - Design #1

Table 8a - Means and Standard Deviations

Group		Pretest	Posttest
Program	M	13.55	42.00
	SD	14.61	19.57
	N	29	
Text	M	13.52	31.45
	SD	9.27	15.39
	N	33	

Table 8b - Analysis of Variance

Source	df	MS	F
Between Subjects			
Groups	1.0	867.62	2.8
Error Between	60.0	309.72	
Within Subjects			
Learning (Pre-Post)	1.0	16676.17	111.18***
Interaction	1.0	857.05	5.71*
Tests XSs w/in gps.	60.0	150.00	
Total	123.0		

Study 9: DeHaan - Design #2

Table 9a - Means of Groups

Group		Pretest-T_1	Posttest-T_2	Final Test-T_3
Program-Discussion	M	4.74	34.11	42.31
	N	35		
Program-Lecture	M	4.93	43.46	44.54
	N	28		

Table 9b - Analysis of Variance

Source	SS	df	MS	F
Between Subjects	16521.19	62		
Groups	718.10	1	718.10	2.77
Error between	15803.09	61	259.07	
Within Subjects	71582.87	126		
tests	55219.61	2	27609.81	215.31***
interaction	719.03	2	359.52	2.80
tests XSs w/in gps.	15644.23	122	128.23	
Total	88104.06	188		

Individual comparisons:

Differences between $T_1 - T_2$, $T_1 - T_3$, $T_2 - T_3$ are significant.

$T_1 = 4.82$, $T_2 = 38.27$, $T_3 = 43.30$

*$P < .05$ **$P < .01$ ***$P < .001$

App E-8 (cont)

Study 10: Schagrin - Design #3

Table 10a -Means and Standard Deviations

Group		Pretest	Posttest
Program then Lecture	M	7.33	42.93
	SD	5.91	11.83
	N	15	
Lecture then Program	M	11.60	49.87
	SD	10.06	13.34
	N	15	

Table 10b- Analysis of Variance

Source	df	MS	F
Between Subjects			
Groups	1.0	470.40	4.00
Error Between	28.0	117.73	
Within Subjects			
Learning (Pre-Post)	1.0	20461.07	187.15***
Interaction	1.0	26.66	.24
tests XSs w/in gps.	28.0	109.33	
Total	59.0		

Study 11: Tovo - Design #4

Table 11a- Means and Standard Deviations

Group		Pretest	Posttest
Program (Volunteers)	M	16.19	52.58
	SD	16.04	18.48
	N	26	
Lecture (Volunteers)	M	14.91	43.14
	SD	14.55	14.21
	N	23	

Table 11b- Analysis of Variance

Source	df	MS	F
Between Subjects			
Groups	1.0	685.21	1.82
Error Between	45.6	377.18	
Within Subjects			
Learning (Pre-Post)	1.0	24874.23	123.86***
Interaction	1.0	396.49	1.97
Tests XSs w/in gps.	45.6	200.82	
Total	94.3		

*P< .05 **P< .01 ***P< .001

App. E-8 (cont)

Study 12: Stephenson and Wilcox - Design #1

Table 12a- Means and Standard Deviations

Group		Pretest	Posttest
Program	M	6.84	50.29
	SD	6.29	18.38
	N	31	
Text	M	8.43	30.68
	SD	5.97	12.15
	N	28	
Lecture	M	5.29	34.47
	SD	7.11	15.62
	N	34	

Table 12b- Analysis of Variance

Source	df	MS	F
Between Subjects			
Groups	2.0	1608.94	8.54**
Error Between	89.4	188.38	
Within Subjects			
Learning (Pre-Post)	1.0	46218.28	386.48***
Interaction	2.0	1800.25	15.05***
Tests XSx w/in gps.	89.4	119.59	
Total	183.8		

Study 13: Yow-Design #1

Table 13a- Means and Standard Deviations

Group		Pretest	Posttest
Program	M	19.68	51.04
	SD	12.56	18.72
	N	27	
Lecture	M	18.84	25.09
	SD	11.05	9.80
	N	30	

Table 13b- Analysis of Variance

Source	df	MS	F
Between Subjects			
Groups	1.0	5033.70	23.19***
Error Between	54.1	217.09	
Within Subjects			
Learning (Pre-Post)	1.0	9926.40	283.31***
Interaction	1.0	4424.65	126.28***
Tests XSs w/in gps.	54.1	35.04	
Total	111.2		

*P< .05　　**P< .01　　***P< .001

E-8
App. (~~E-8~~)(cont)

[redacted]

Study 14: Stephenson and Wilcox

Table 14a- Means of Groups

Group		Pretest-T_1	Posttest-T_2	Final Test-T_3
Program-Discussion	M	8.96	60.56	51.96
	N	27		
Program-Lecture	M	6.25	46.03	42.36
	N	28		
Program-Discussion	M	5.82	57.65	47.88
(Mixed)	N	17		

Table 14b - Analysis of Variance

Source	SS	df	MS	F
Between Subjects	55,897.09	71		
Groups	2,808.16	2	1404.08	1.82
Error Between	53,088.93	69	769.40	
Within Subjects	111,360.00	144		
tests	90,973.80	2	45486.90	325.53***
interaction	1,103.21	4	275.80	1.97
tests XSs w/in gps.	19,282.99	138		
Total	167,257.09	215		

Individual Comparisons:

Differences between T_1-T_2, T_1-T_3, T_2-T_3 are significant.

$T_1 = 6.67$, $T_2 = 54.75$ $T_3 = 47.40$

*P < .05 **P < .01 ***P < .001

Study 15: Patton - Design #3

Table 15a- Means and Standard Deviations

Groups		Pretest	Posttest
Program then Lecture	M	4.96	74.54
	SD	6.65	16.29
	N	28	
Lecture then Program	M	7.33	74.08
	SD	8.88	17.93
	N	24	

Table 15b- Analysis of Variance

Source	df	MS	F
Between Subjects			
Groups	1.0	23.75	.10
Error Between	49.6	241.09	
Within Subjects			
Learning(Pre-Post)	1.0	120078.20	809.15***
Interaction	1.0	51.43	.35
Tests XSs w/in gps	49.6	148.4	
Total	102.3		

*P < .05 **P < .01 ***P < .001

App. E-8 (cont)

Study 16: Wilson - Design #4

Table 16a- Means and Standard Deviations

Group		Pretest	Posttest
Program	M	6.23	71.70
	SD	6.64	14.73
	N	30	
Lecture	M	8.21	59.30
	SD	7.65	19.42
	N	33	

Table 16b- Analysis of Variance

Source	df	MS	F
Between Subjects			
Groups	1.0	852.80	3.91
Error Between	60.8	218.17	
Within Subjects			
Learning (Pre-Post)	1.0	106744.53	1004.40***
Interaction	1.0	1623.79	15.28***
Tests XSs w/in gps.	60.8	106.28	
Total	124.7		

Study 17: Vulgamore - Design #1

Table 17a- Means and Standard Deviations

Group		Pretest	Posttest
Program	M	2.20	71.15
	SD	3.96	12.29
	N	20	
Lecture	M	1.84	62.32
	SD	1.61	11.09
	N	19	

Table 17b- Analysis of Variance

Source	df	MS	F
Between Subjects			
Groups	1.0	411.65	4.76*
Error Between	36.9	86.48	
Within Subjects			
Learning (Pre-Post)	1.0	81604.93	1028.38***
Interaction	1.0	350.07	4.41*
Tests SXs w/in gps.	36.9	79.35	
Total	76.9		

$*p < .05$ $**p < .01$ $***p < .001$

App E-8 (cont)

[redacted]

Study 18: Stegner - Design #1

Table 18a- Means and Standard Deviations

Group		Pretest	Posttest
Program	M	14.76	65.66
	SD	7.90	15.92
	N	29	
Lecture	M	14.07	60.80
	SD	9.39	13.11
	N	30	

Table 18b- Analysis of Variance

Source	df	MS	F
Between Subjects			
Groups	1.0	226.88	1.44
Error Between	56.9	157.22	
Within Subjects			
Learning (Pre-Post)	1.0	70275.33	558.20***
Interaction	1.0	127.77	1.01
Tests X Ss w/in gps	56.9	125.90	
Total	116.9		

Study 19: Scott - Design #2

Table 19a- Means of Groups

Group		Pretest-T_1	Posttest-T_2	Final Test-T_3
Program-Discussion	M	26.36	77.14	77.77
	N	22		
Program-Lecture	M	15.54	78.00	77.00
	N	27		

Table 19b- Analysis of Variance

Source	SS	df	MS	F
Between Subjects	3878.59	47		
Groups	457.73	1	457.73	6.16*
Error Between	3420.86	46	74.37	
Within Subjects	109684.33	96		
tests	101565.08	2	50782.54	65.22***
tests X Sx w/in gps	7163.75	92	77.87	
interaction	955.51	2	477.75	6.14*
Total	113562.92	143		

Individual Comparisons:

Differences between T_1 - T_2 and T_1 - T_3 are significant.
Difference between T_2 - T_3 is not significant.
T_1 = 20.50, T_2 = 77.61, T_3 = 77.35

*P < .05 **P < .01 ***P < .001

App. E-8 (cont)

[redacted]

Study 20: Stegner and Stone - Design #3

Table 20a- Means and Standard Deviations

Group		Pretest	Posttest
Program then Lecture	M	29.64	79.89
	SD	4.76	7.05
	N	28	
Lecture then Program	M	31.93	81.59
	SD	11.41	8.09
	N	29	

Table 20b- Analysis of Variance

Source	df	MS	F
Between Subjects			
Groups	1.0	112.94	1.39
Error Between	54.9	81.07	
Within Subjects			
Learning (Pre-Post)	1.0	71093.08	1179.18***
Interaction	1.0	2.51	.04
Tests X Ss w/in gps	54.9	60.29	
Total	112.9		

Study 21: Wirt - Design #1

Table 21a- Means and Standard Deviation

Group		Pretest	Posttest
Program	M	49.33	73.17
	SD	11.39	8.12
	N	18	
Lecture	M	45.83	67.25
	SD	12.61	10.78
	N	16	

Table 21b- Analysis of Variance

Source	df	MS	F
Between Subjects			
Groups	1.0	372.25	1.63
Error Between	31.8	228.82	
Within Subjects			
Learning (Pre-Post)	1.0	8656.08	127.54***
Interaction	1.0	25.60	.38
Tests X Ss w/in gps	31.8	67.87	
Total	66.7		

$*P < .05$ $**P < .01$ $***P < .001$

App E-8 (cont)

Study 22: McNaghten - Design #2

Table 22a- Means of Groups

Group		Pretest-T_1	Post-test-T_2	Final Test-T_3
Program and Discussion	M	46.32	66.34	66.61
	N	38		
Program and Lecture	M	40.63	59.21	66.73
	N	19		

Table 22b- Analysis of Variance

Source	SS	df	MS	F
Between Subjects	87650.57	56		
Groups	679.90	1	679.90	.43
Error Between	86,970.94	55	1581.29	
Within Subjects	24049.33	114		
tests	15647.03	2	7823.51	107.11***
tests X Sx W/in gps.	8033.94	110	73.04	
interaction	374.67	2	187.33	2.57
Total	111699.90	170		

Individual Comparisons:

Differences between T_1-T_2 and T_1-T_3 are significant.
Difference between T_2.T_3 is not significant.
$T_1=44.42$, $T_2=63.96$, $T_3=66.65$

Study 23: Morey - Design #3

Table 23a- Means and Standard Deviations

Group		Pretest	Posttest
Program then Lecture	M	43.10	68.35
	SD	9.34	10.19
	N	20	
Lecture then Program	M	50.13	66.33
	SD	7.49	9.08
	N	15	

Table 23b- Analysis of Variance

Source	df	MS	F
Between Subjects			
Groups	1.0	107.86	.48
Error Between	32.2	227.02	
Within Subjects			
Learning (Pre-Post)	1.0	7363.30	114.26***
Interaction	1.0	351.02	5.45*
Tests X Sx w/in gps.	32.2	64.44	
Total	67.5		

*$P < .05$ **$P < .01$ ***$P < .001$

App E-8 (cont)

Study 24: Westbrook - Design #4

Table 24a- Means of Groups

Groups		Pretest	Posttest
1: Volunteers -	M	45.73	62.91
extra credit	N	11	
2: Volunteers -	M	58.27	72.18
required credit	N	11	
3: Nonvolunteers -	M	48.45	63.09
extra credit	N	11	
4: Nonvolunteers -	M	53.45	59.73
required credit	N	11	

Table 24b- Analysis of Variance

Source	df	MS	F
Between Subjects			
A-Vol. vs Non Vols.	1	283.68	1.79
B-Extra vs Req. Cred.	1	756.41	4.76*
AB-Interaction	1	560.05	3.53
Error Between	40	158.75	
Within Subjects			
C Learning (Pre-Post)	1	3,718.00	42.81***
AC-Interaction	1	142.55	1.64
BC-Interaction	1	186.18	2.14
ABC-Interaction	1	35.64	- - -
Tests X Sx w/in gps.	40		
Total	87		

*P< .05 **P< .01 ***P< .001

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

$$df = n_1 + n_2 - 2$$

$$\bar{X}_i = \frac{\Sigma X_i}{N_i}$$

$$s^2 = \frac{N \Sigma X_i^2 - (\Sigma X_i)^2}{N(N-1)}$$

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2} - 2 r_{12} \frac{s_1}{\sqrt{n_1}} \cdot \frac{s_2}{\sqrt{n_2}}}}$$

$$df = n - 1$$

$$(n_1 \equiv n_2)$$

$$\bar{X}_i = \frac{\Sigma X_i}{N_i}$$

$$s^2 = \frac{N \Sigma X_i^2 - (\Sigma X_1)^2}{N(N-1)}$$

$$s = \sqrt{s^2}$$

$$r = \frac{N \Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{N \Sigma X^2 - (\Sigma X)^2} \sqrt{N \Sigma Y^2 - (\Sigma X)^2}}$$

FACTOR LEVELS

$A = 1, 2, \cdots i \cdots p.$

$B = 1, 2, \cdots j \cdots q.$

$C = 1, 2, \cdots k \cdots r.$

$D = 1, 2, \cdots l \cdots n.$

(1) $$\left[\sum_{i}^{p}\sum_{j}^{q}\sum_{k}^{r}\left(\frac{\sum^{n} X}{n}\right)\right]^2 \Big/ pqr$$

(2) $$\sum_{i}^{p}\sum_{j}^{q}\sum_{k}^{r}\sum_{l}^{u} X_{ijkl}^2$$

(3) $$\sum_{i}^{p}\left[\sum_{j}^{q}\sum_{k}^{r}\left(\frac{\sum^{n} X}{n}\right)\right]^2 \Big/ qr$$

(4) $$\sum_{j}^{q}\left[\sum_{i}^{p}\sum_{k}^{r}\left(\frac{\sum^{n} X}{n}\right)\right]^2 \Big/ pr$$

(5) $$\sum_{k}^{r}\left[\sum_{i}^{p}\sum_{j}^{q}\left(\frac{\sum^{n} X}{n}\right)\right]^2 \Big/ pq$$

(6) $$\sum_{i}^{p}\sum_{j}^{q}\left[\sum_{k}^{r}\left(\frac{\sum^{n} X}{n}\right)\right]^2 \Big/ r$$

(7) $$\sum_{i}^{p}\sum_{k}^{r}\left[\sum_{j}^{q}\left(\frac{\sum^{n} X}{n}\right)\right]^2 \Big/ q$$

(8) $$\sum_{j}^{q}\sum_{k}^{r}\left[\sum_{i}^{p}\left(\frac{\sum^{n} X}{n}\right)\right]^2 \Big/ p$$

(9) $$\sum_{i}^{p}\sum_{j}^{q}\sum_{k}^{r}\left[\frac{\sum^{n} X}{n}\right]^2$$

(10) $$\sum_{i}^{p}\sum_{j}^{q}\sum_{l}^{n}\left(\sum_{k}^{r} X\right)^2 \Big/ r$$

(11) $$\tilde{n} = pq \Big/ \Sigma\left(\frac{1}{n}\right)$$

Source of variation	Σx^2	df
Between Subjects	$(10)-\tilde{n}(1)$	$\tilde{n}pq-1$
A	$\tilde{n}[(3)-(1)]$	$p-1$
B	$\tilde{n}[(4)-(1)]$	$q-1$
AB	$\tilde{n}[(6)+(1)-(3)-(4)]$	$(p-1)(q-1)$
Errorbetween	$(10)-\tilde{n}(6)$	$pq(\tilde{n}-1)$
Within Subjects	$(2)-(10)$	$\tilde{n}pq(r-1)$
C	$\tilde{n}[(5)-(1)]$	$r-1$
AC	$\tilde{n}[(7)+(1)-(3)-(5)]$	$(p-1)(r-1)$
BC	$\tilde{n}[(8)+(1)-(4)-(5)]$	$(q-1)(r-1)$
ABC	$\tilde{n}[(9)+(3)+(4)+(5)-(6)-(7)-(8)-(1)]$	$(p-1)(q-1)(r-1)$
Error w/in	$(2)-(10)+\tilde{n}[(6)-(9)]$	$(pq)(\tilde{n}-1)(r-1)$
TOTAL	$(2)-\tilde{n}(1)$	$\tilde{n}pqr-1$

Source of variation	Σx^2	df	mS	F
Between Subjects				
A	SS_A	df_A	mS_A	mS_A/mS_{eb}
B	SS_B	df_B	mS_B	mS_B/mS_{eb}
AB	SS_{AB}	df_{AB}	mS_{AB}	mS_{AB}/mS_{eb}
Error Btwn	SS_{eb}	df_{eb}	mS_{eb}	—
Within Subjects				
C	SS_C	df_C	mS_C	mS_C/mS_{ew}
AC	SS_{AC}	df_{AC}	mS_{AC}	mS_{AC}/mS_{ew}
BC	SS_{BC}	df_{BC}	mS_{BC}	mS_{BC}/mS_{ew}
ABC	SS_{ABC}	df_{ABC}	mS_{ABC}	mS_{ABC}/mS_{ew}
Error W/in	SS_{ew}	df_{ew}	mS_{ew}	—
TOTAL	SS_{TOT}	df_{TOT}	—	—

APPENDIX E-11

Means and Standard Deviations and N's of GLCA Produced Programs

	1 (Poetry)		2 (Logic)		3(Biochemistry)		4 (Religion)		5 (Pol.Sc.)	
	Means	Std. Dev.	Means	Std. Dev.	Means	Std. Dev.	Means	Std. Dev.	Means	Std. Dev.
Sex	1.41	.49	1.50	.50	1.63	2.82	1.53	.50	1.28	.45
Class	1.55	.74	2.48	1.16	1.51	.75	1.52	.75	2.41	1.12
CEEB-m	603.30	90.92	571.73	125.60	589.76	88.00	575.66	92.76	611.13	70.35
CEEB-V	566.78	83.10	560.16	97.56	572.63	76.70	557.64	78.07	577.71	70.96
PRE-TEST	30.16	60.45	4.58	32.13	7.36	21.09	21.49	14.79	47.45	9.72
POST-TEST	53.20	24.79	45.13	17.39	60.15	36.70	75.74	11.54	65.64	12.50
RANK	77.74	27.87	79.21	93.17	79.59	24.51	86.88	52.20	82.13	36.47
Q2-A	5.87	2.56	8.08	4.88	12.43	9.00	3.56	1.31	5.25	2.84
Q4-A	1.78	4.35	1.90	1.00	1.86	.83	1.77	.95	2.32	1.02
Q5-A	2.02	.99	2.35	1.00	1.80	.99	2.31	.71	3.77	20.21
Q6-A	2.22	1.00	2.24	.90	2.28	.89	1.87	.72	2.49	.87
Q7-A	1.59	3.03	2.66	1.35	2.14	1.19	1.64	.95	2.13	3.48
Q8-A	1.87	.92	1.26	.82	1.86	9.53	1.57	.84	1.91	1.51
Q9	2.45	.94	2.50	.79	2.38	1.01	2.19	.88	2.61	1.17
Q10-A	1.62	.71	1.63	.67	1.60	.66	1.50	.65	1.91	.67
Q11-A1	3.28	1.09	3.74	1.01	3.73	1.01	3.59	1.17	3.02	1.03
Q11-A2	2.88	.75	2.77	.70	2.44	.86	3.43	1.05	2.91	.61
Q11-A3	2.50	1.14	2.22	1.07	2.49	1.27	2.19	1.13	2.78	1.00
Q11-A4	3.15	1.07	2.83	1.05	3.19	.97	2.80	.95	3.38	.84
Q12	1.45	.65	1.32	.47	1.30	.46	1.48	.57	1.59	.49
Wt'd. N	152		197		215		155		151	

APPENDIX F-1

THE INTERVIEW-SCHEDULE

Each question (1-9) is based on its corresponding assumption.

1. How do you feel about your present teaching procedures? What do you like to dislike about them? Are there any next steps you would like to take in the development of your teaching?

2. In preparing or revising a course, how much attention would you give to preparation of content as compared with the methods through which the content will be presented. Why?

3. Briefly, what do you see as the role, or functions and responsibilities a) of the teacher? b) of the student? (If presenting the students with questions and problems or giving opportunities for questions and discussions or interaction is mentioned, then ask: Just how is this done? for what purposes?)

4. Do course objectives need to be expressly formulated or not? (If interviewee says they need to be so formulated, then ask: how would they be formulated? how specifically? In what terms? Can you give an example of one or two of your objectives?)

5. Is there any way of knowing whether students attain these objectives? (If yes, how do you know?)

6. Is there any need for the teacher to analyze and organize course material before presenting it to students? (If yes, in what specific ways? What principles, if any, of organization do you feel should be followed? If principles are mentioned then ask: Can you give one or two illustrations of how you would apply these principles?)

7. Is there any need for taking into account students' previous learning - how much they already know before entering your courses or a particular session of a course? (If yes, how would you find out what the student knows and takes into account?)

8. What find of relationship do you favor for yourself between students and teachers in the classroom?

9. What do you think are the major sources of motivation for the students in your classes. What causes them to work? Do you find it necessary or desirable to motivate students? (If so, how?)

Appendix F-1 (Cont)

10. When and how frequently do you assess or evaluate the knowledge, understandings, etc. students have gained in your courses? (Every session, weekly, mid-term, end of year?) Why? What is the purpose of these evaluations? What use is made of them?

11. What are your impressions of the new instructional media and of their uses? Which, if any, do you use? Would like to use?

12. Which, if any, of the answers you have given in this interview represent very recent changes in your thinking?

13. Do you happen to be familiar with the methods used in the development of programed instruction? If yes, do you feel that the principles and techniques involved in the preparation of programed instruction have, or do not have, application to other methods of instruction? In other words, are the principles and techniques of programing applicable only to preparing programs or do they have broader applicability in education? If yes, just how are they applicable? To what specific methods of teaching? (The judges were not given the answers to this question).

APPENDIX F-2

TABULATION OF JUDGES RATINGS-JUDGE A

INT.
QUEST.

INTERVIEWEES*

	P	C-U	C-U	P	P	C-U	C-I	P	P	P	C-I	C-I	C-I	P	P	C-I	C-I	C-U	P	C-U	P	P	C-U
1	5	2	4	3	3+	2+	2	3	3	2	4	5	4	3+	4	2	1	2	1	1	1	3	3
2	2-	1	4	4-	2	2	2	2-	2-	3	1	2	2	1	3-	1	1	2+	3-	1	2	2	1
3	3	4	3	5	3	3	3+	2	4	2	2	3	2	2	3	1	1	2	3-	2	3	3	2
4	4	4	3	5	4	3	4	2+	4-	1	2+	4	1	4	3	3	3	2	4	3+	5	3	3
5	4	3	4	4	3	2	3-	2	2	1	1	3-	2+	1	3	3-	3	2	4	2	3+	3	2
6	5	1	1	4-	3	3	3	3	4	4	1	4	2	2	2-	1	3	1	4	3+	3	3	2+
7	4	3+	3	3	1	2	4	2	4+	3	3	4	4	3	1	2	3	1	3	2	2	1	3
8	5	2	3	4	3	1	3	3+	3	1	3-	3+	2+	4	2	1	3	3	3+	1	4	2+	4
9	3+	2	4	4-	1	1	3-	2+	2+	1	2	3	2	1	2+	2	1	4	3	2	4	2	1
10	3	2	3+	5	1	3	2	3	3	3+	3	3+	2	2+	2	1	2+	3	4	1	3	3	2
11	4	2	3+	3+	4	2	3	5	4	3	3+	5	3	5	2+	2	4	2-	5	3	4	4	1
12	4	2	--	2	3-	2	2+	2+	3	2	2	2	3	2	3	2	2	2	3	2	3-	2	2
Sum	46	28	38	46	31	26	34	31	38	26	27	41	29	30	30	21	27	26	40	25	37	31	26

P designates programs.
C-U designates uninformed controls.
C-I designates unformed controls.

TABULATION OF JUDGES RATINGS-JUDGE B

INT.
QUEST.

INTERVIEWEES

	P	C-U	C-U	P	P	C-U	C-I	P	P	P	C-I	C-I	C-I	P	P	C-I	C-I	C-U	P	C-U	P	P	C-U
1	3	2	3+	3	3	3	2	3	3	2	3	4	2	4	3	2	2	2	3	2	2	2	3
2	3	1	3	4	3	3	2	3	4	4	2	2	2	1	4	1	2	2	4	1	3	3	3
3	3	3	2	5	3	2	2	2	3	2	3	3	2	1	3	2	2	2	2	2	3	3	2
4	4	4	3	4	4	2	4	2	4	1	3	2	1	3	3	2	3	2	4	3	5	3	2
5	4	4	2	4	2	2	2	1	2	3	1	3	3	3	2	2	2	2	4	1	5	1	1
6	5	4	1	3	3	2	3	2	3	2	3	2	2	2	1	2	3	3	3	3	2	4	3
7	4	4	4	4	2	2	4	2	5	3	2	4	4	3	2	3	3	3	3	4	3	2	2
8	5	3	3	5	3	2	3	3	4	1	1	3	3	2	3	2	3	3	4	2	4	2	4
9	5	3	4	5	1	1	3	3	4	2	4	3	2	2	3	3	2	4	4	3	5	3	1
10	2	2	2	4	1	4	4	3	3	4	4	4	2	4	1	1	4	3	5	3	2	1	3
11	4	2	3	4	4	2	3	4	4	3	3	5	3	4	2	2	4	2	4	3	3	4	2
12	4	1	2	2	3	2	3	2	4	1	1	1	4	1	4	1	1	2	4	1	4	1	1
Sum	46	33	32	47	32	27	35	30	43	28	36	36	30	30	31	23	31	31	44	28	41	29	27

APPENDIX F-2 (Cont)
TABULATION OF JUDGES RATINGS-JUDGE C

INT.
QUEST.

INTERVIEWEES

	P	C-U	C-U	P	P	C-U	C-I	P	P	P	C-I	C-I	C-I	P	P	C-I	C-I	C-U	P	C-U	P	P	C-U
1	3+	2	4	4-	3	2+	3	2+	4-	2	3	4	2+	4	2+	2+	2-	2	2+	2	2	3+	2+
2	3	2	3	4	2	2	2	2+	3	4	1+	2	2	1	3	1	2	1	2	2-	2	3	2
3	3-	3-	2+	4+	2+	2+	3-	2	4	2	2	3	2	2	3-	2	2	3	2	2+	4	2	2
4	4+	4	4-	3	4	3-	5-	3+	4-	1	3	3	2-	4	4-	3-	2	2-	4-	3-	4+	4-	2+
5	3+	2	3	4-	2+	2	3	2	2+	2-	1	3+	2+	1+	2+	3-	3	2-	4-	2	4	2	2
6	4+	3	2-	2	3	2+	2+	2+	2+	3-	2	2+	2+	2	2-	3-	2+	2+	2+	3	2+	3-	2
7	3-	3-	3	3	1+	2	3-	2+	4	2	2-	3	4	3+	2-	1+	3-	3	3-	3+	2	2	3-
8	4-	2	3	3+	3	2+	4-	3	4-	1+	3-	3+	3-	3	2+	1	3	3+	3	1+	4	3-	4
9	3-	2+	3	4	1+	1	3	2+	3-	2-	1+	1	2+	1	3-	2	1	3-	4-	3	3+	2-	1+
10	3	2+	2+	5-	2-	3-	3	3-	3+	4-	3	4	2+	2+	2	2	3-	2+	4	1	3-	3-	2+
11	3-	2	2-	3	3-	2	3+	3+	3+	3+	2	4+	2+	4	2	2-	3-	1+	3	2	3	4-	2-
12	3	2	2	2	3-	2-	2+	2+	3	2	2	2	3	2	3-	2	2	2	3+	2	3+	2	2
Sum	39	29	33	41	29	25	36	28	39	28	25	34	28	29	30	24	28	26	36	26	36	33	26

APPENDIX F-3

AVERAGE INTERCORRELATION AMONG JUDGES

$$S = R^2 - \frac{(\ R)^2}{N} \qquad W = \frac{125}{K^2N(N^2-1)}$$

$$= \underline{41{,}661.5 - 32{,}266.6} = 9{,}394.9$$

$$W = \frac{112{,}738.8}{124{,}200.0} = .908$$

$$\overline{R} = \frac{KW-1}{K-1} = \frac{2.724-1}{2} = \frac{1.724}{2} = .862$$

$$^2{}_w = k(N-1)W = 62.652,\ p\ \ .001$$

$$^2\ {}_{.001}(23) = 49.73$$

APPENDIX F-4

DIFFERENCE BETWEEN PROGRAMERS & NON-PROGRAMERS

^{2} text

	Prog:	Non-Prog:	
Above Mdn	9	3	12
Below Mdn	3	9	12
	12	12	24

$$^2 = \frac{N(\ AD-BC\ -\frac{N}{2})^2}{(A+B)(C+D)(A+C)(B+D)};\ df = (k-1)(r-1)$$

$$^2 = \frac{24(\ 81-9\ \ -12)^2}{12 \times 12 \times 12 \times 12} = \frac{24(3600)}{20{,}736} = \frac{86400}{20736}$$

$$= 4.17\ \ p\ .05$$

$$^2\ {}_{.05}(1) = 3.8$$

APPENDIX F-5

PROGRAMERS VS. UNINFORMED CONTROLS

Mann-Whitney U-Test

Working with the sum of ranks

Sum of ranks programers $R_1 = 139.5$ $n_1 = 12$

Sum of ranks uninformed controls $R_2 = 31.5$ $n_2 = 6$

$$U = n_1 n_2 + \frac{n_1(n_1+1)}{2} - R_1$$

$$= 150 - 139.5 = \underline{\underline{10.5}} \qquad p\ .01$$

$$U = 11.$$

APPENDIX F-7

There was no way in which to analyze the data by means of existing tests, so we devised our own method of analysis.

1. Basic assumptions:

Let A and B be two p x q matrices composed of aij and bij elements respectively where

$$i = 1,2,3...p$$

$$j = 1,2,3...q$$

By means of matrix subtraction, a difference matrix, D, consisting of dij = aij - bij elements may be obtained.

If the elements of A and B are random variates, then it follows that

$$\underline{\overset{p}{\ }\qquad\overset{q}{\ }\qquad dij} = 0$$

or

$$E\ (d) = o$$

According to the central limits theorem, the sampling distribution of d is expected to be normal.

Assuming that the D matrix is obtained from A and B which are composed of random variates, it is possible to contrast the properties of D with those of another difference matrix, D', consisting of d'ij = a'ij - b'ij are the elements of A' and B' should be the same size. The sampling distribution of d' is expected to be normal.

If the distributions are normal, then the distribution of the difference scores between the two distributions are also normally distributed, therefore, the hypothesis that the two distributions, D and D' are drawn from the same population may be tested by the ratio;

$$z = \bar{d}/sd.$$

2. Procedure

a) computation of d' matrix

$$dij = \bar{P}ij - \bar{c}ij$$

2. b) Analysis of d' by Judges (Table 2) shows that the judges differ with respect to discrimination - for example, judge B has a higher discrimination index than judge A or C. However, the reliability coefficient, r = .78, indicates a high degree of concordance among the judges.

c) The differences between the informed and uninformed control groups are not significant, F (2.33) = .15, p .05.

d) The differences between the items (Table 3) are significant, F (11,24) = 4.42, p .01. The last column on Table 1 gives the rank order of the items in terms of their discriminability.

e) The ratio $\overline{d}/sd$ - .489/.4 = 1.22 (Table 1) indicates that the D matrix as a whole is a useful device. The probability is .90 that the observed D' matrix is different from an expected D matrix.

Table 1

D^1 Matrix and Summary Statistics

Judges Items	A	B	C	k di	k 2 di	- di	Item Rank
1	.16	.33	1.08	1.57	1.30009	.5233	7
2	.58	1.16	.67	2.41	2.1309	.8033	2
3	.75	.50	.50	1.75	1.0625	.5833	5
4	.42	.58	.41	1.41	.6809	.4700	9
5	.16	.67	.17	1.00	.5034	.3333	10
6	1.33	.25	.25	1.83	1.8939	.6099	4
7	-.42	-.34	-.34	-1.10	.4076	-.3666	12
8	.75	.59	.34	1.68	1.0262	.5599	6
9	.08	.66	.74	1.48	.9896	.4933	8
10	.66	-.25	.58	.99	.8345	.3300	11
11	.67	.92	.83	2.42	1.9842	.8066	1
12	.50	1.16	.50	2.16	1.8456	.7199	3

dj 5.64 6.23 5.73 17.60

r 2
dj 4.7752 5.7061 4.1789 14.6602

$\bar{d}$j .4700 .5191 .4775 .489

(dj)^2= 35.3974

$S_d{}^2$ = 0.16

Sd = 0.4

Table 2

Analysis of d' by Judges

Source of variation	SS	df	MS	F
Between Items	5.97	11	.54	
Within Items	2.86	24	.12	
Between Judges	2.27	2	1.14	38.00 ***
Residual	.59	22	.03	
Total	8.83	35		

*** p .001

$$r = 1 - \frac{MSw/items}{MSb/items}$$

$$= 1 - .22$$

$$= .78$$

Table 3

Analysis of d' by Items

Source of Variation	SS	df	MS	F
Between Items	5.83	11	.53	4.42 **
Error	2.86	24	.12	
Total	8.69	35	-	

**p .01